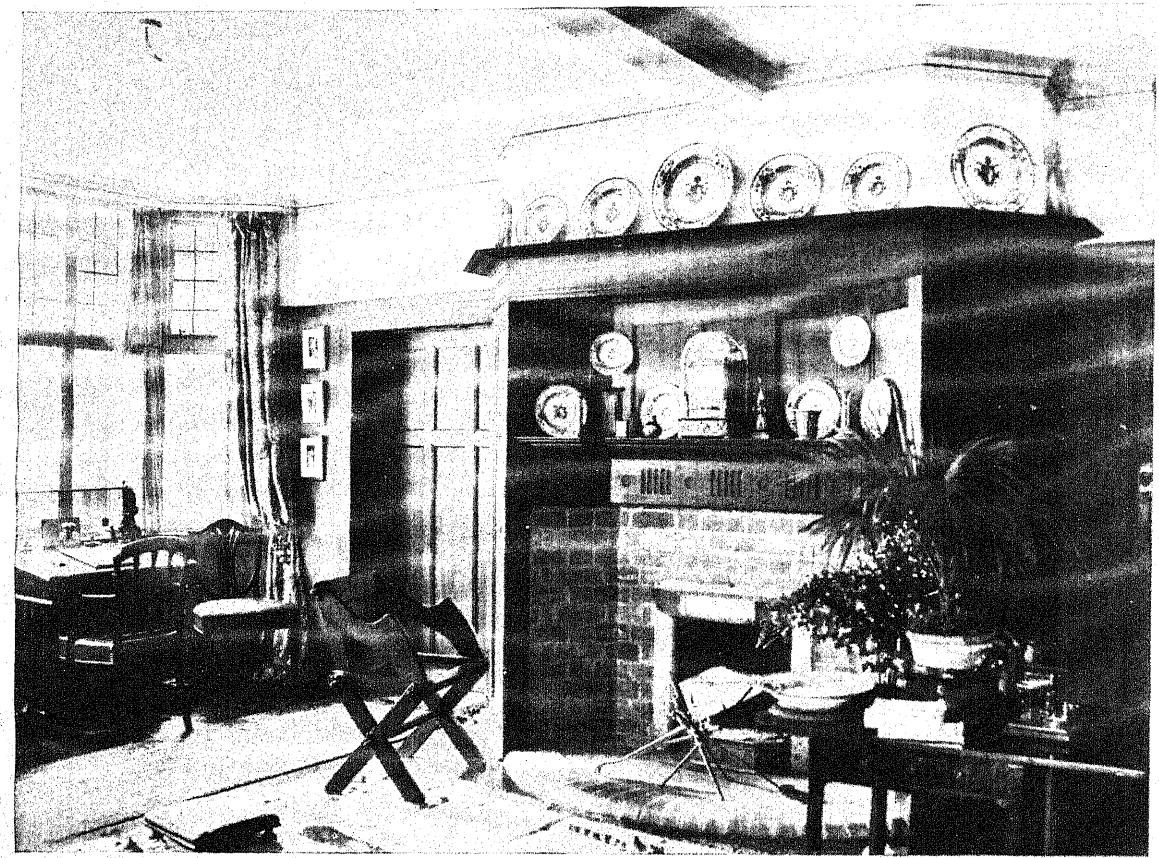

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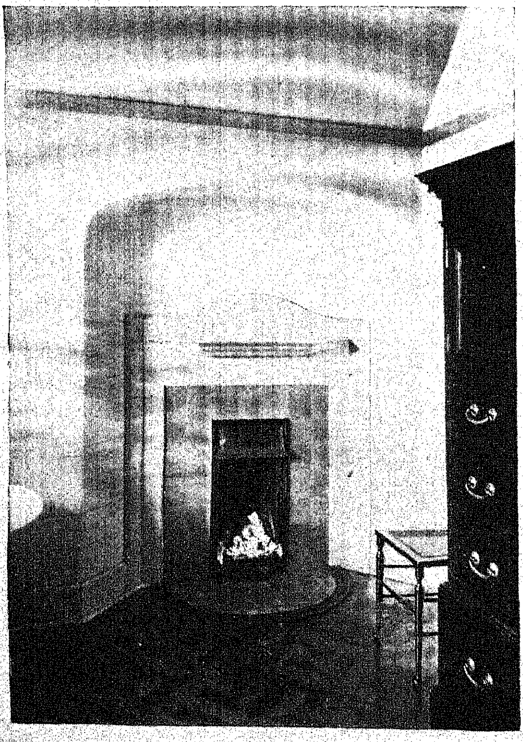

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2, 3. DRESSING-ROOM AND MORNING-ROOM,
"", BYFLEET.

The Principles & Practice of MODERN HOUSE CONSTRUCTION

INCLUDING PLAN AND DESIGN : CONSTRUCTION : WATER-SUPPLY AND FITTINGS : SANITARY FITTINGS & PLUMBING : DRAINAGE & SEWAGE-DISPOSAL : WARMING : VENTILATION : LIGHTING : STABLES & COW-HOUSES : SANITARY LAW : &c.

BY MANY LEADING SPECIALISTS
UNDER THE EDITORSHIP OF

G. Lister Sutcliffe

ASSOCIATE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS
MEMBER OF THE ROYAL SANITARY INSTITUTE

NEW EDITION

Thoroughly revised and considerably extended

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SEWAGE-DISPOSAL

BY

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M.INST.C.E., F.SAN.INST., ETC.

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SECTION VIII.—SEWAGE-DISPOSAL.

CHAPTER I.

SEWAGE.

An important consideration, so far as a sanitary house is concerned, is the getting rid of the waste products known as "sewage", in a manner that shall be expeditious, inoffensive, and economical. The question of sanitary appliances, drains, and traps has been dealt with by other contributors, but the question of the ultimate disposal of the sewage must now be considered.

In nearly every town or large community in the United Kingdom, the sewage from the houses now passes by underground conduits or drains direct into the arterial system of sewers, to be ultimately dealt with in a variety of ways which will be presently described. The disposal of the sewage from isolated or country houses is a more difficult problem, which in its turn will also be discussed. Before proceeding to deal with the question of the disposal of sewage from towns, it will be well to consider its composition and quantity.

Sewage may be described as the various waste products from communities, mixed with a quantity of water which varies with the supply, and the admittance or otherwise of the subsoil and rain water, and also the habits of the community. The measure of the dry-weather flow may be readily estimated, when the supply of water per head of the population is ascertained, but allowance must be made for subsoil water in those cases where it is admitted, either purposely or accidentally, into the drains and sewers. In addition to which must be added the "manufacturers' waste", which in some special cases is necessarily considerable. The storm-water flow, which is dependent upon the rainfall, is, on the other hand, somewhat difficult to estimate, without a series of observations extending over a considerable period of time, and made with a view to estimate the amount of the rainfall upon the area drained by the sewers; and provision must be made for dealing in some manner with the *maximum* quantity of water which is likely to reach these sewers.

With regard to the chemical composition and degree of dilution of any sewage, this must also necessarily vary in every district, but the late well-known chemist, Dr. C. Meymott Tidy, made the following determination of the **excrementitious matter in sewage:—**

"Every adult male person voids on an average 60 ozs. (= 3 pints) of urine daily. The 60 ozs. contains an average of 2·53 ozs. of dry solid matter, consisting of—

Urea, ...	512·4 grains.
Extractives (pigment, mucus, uric acid), ...	169·5 „
Salts (chiefly chlorides of sodium and potassium), ...	425·0 „
	1106·9 = 2·53 ozs.

"Every adult male person voids about 1750 grains (or 4 ozs.) of fæces daily, of which 75 per cent is moisture. The dry fæcal matter passed daily is therefore about 1 oz. per adult head of the population. Of this dry fæcal matter, about 88 per cent is organic matter (of which 6 parts are nitrogen), and 12 per cent inorganic (of which 4 parts are phosphoric acid); of this dry fæcal matter, 11 per cent is soluble in water."

Other experimentalists give about 36 ozs. of urine and 1½ ozs. of fæcal matter for each person in 24 hours, and Messrs. Wolff & Lehmann, from investigations made with a mixed population of 100,000 persons for a year, give the following result:—3 ozs. of fæcal matter and 26 ozs. of urine per day. It will thus be seen that there is some divergence of opinion as to the average amount of these matters voided daily by an adult, and it is really more important for our purpose to ascertain what is the composition of water-carried sewage. This was determined by the Rivers Pollution Commissioners in their first report as follows:—

TABLE XXV.

DISSOLVED AND SUSPENDED MATTER IN SEWAGE.

IN PARTS PER 100,000.

Description.	Matter in Solution.	Suspended Matter.			Total in Solution and Suspension.
	Total Solids.	Mineral.	Organic.	Total.	
Water-closet Towns, -	72·2	24·18	20·51	44·69	116·89
Midden Towns, - -	82·4	17·81	21·30	39·11	121·51

This shows that there is as a rule only ·116 per cent of solid matters, in solution and suspension, in water-carried sewage in this country. It must not, however, be forgotten that this solid matter is of an extremely putrescible character, and hence the danger of untreated sewage, especially in cases where there may be in addition large numbers of dangerous pathogenic bacteria, or disease-germs. The

problem is to remove from the sewage and render innocuous the whole of this decomposable organic matter (small though it is in proportion to the large volume of water in which it is carried), and also to destroy the dangerous germs which are carried in it, and which, if allowed to mix with the air we breathe or the water we drink, become so dangerous to our health and lives.

Up to the present date the following may be taken as **the various methods of sewage-disposal** which have been tried:—

(1) *Outfalls into the sea, estuaries, or large rivers*: in other words, disposal by dilution.

(2) *Treatment of the sewage with various chemicals in tanks or otherwise*: in other words, disposal by antiseptic treatment or precipitation.

(3) *Filtration through artificial filters* of various kinds, or through land: in other words, disposal by mechanical separation of the solids, and by nitrification.

(4) *Broad irrigation*: in other words, using the sewage for manurial purposes on land, and at the same time purifying it by filtration and nitrification.

(5) *Septic or natural decomposition*: in other words, allowing natural decomposition to act on sewage and to break up and destroy the solids, and allowing nitrification to purify the effluent. This treatment is gradually superseding chemical treatment.

CHAPTER II.

OUTFALLS INTO THE SEA, ESTUARIES, AND LARGE RIVERS.

Under certain circumstances and with proper precautions, **the discharge of crude sewage into the sea** can be carried out in a satisfactory manner without danger of any nuisance, and such a disposal has much to recommend it. All towns situated on our coasts deal with their sewage in this manner, and it is only where the outfalls have been badly selected that any evils result. There are many scientists who contend that this is a wasteful practice, and that the valuable manure contained in sewage should be returned to the land from whence it originally came in the form of food; but hitherto it has been found that, owing to the enormous dilution by water of the more valuable manurial products in sewage, it is more economical to dispose of sewage in the most rapid and sanitary manner and deal with the land in other ways.

The essential points to be considered in dealing with this method of sewage-disposal may be briefly stated. The outfall must be carried well below the low-water mark of the lowest known tide; otherwise a nuisance is very likely to be caused. It must also be carried to such a point that the incoming tide or wind will not bring the sewage back upon the shore, and that the sweep of any currents in the locality will not have the same effect upon adjacent coasts.

In order to obviate such a possibility, and also to ensure that the point of outlet is so selected that the sewage will always, under all conditions of winds and tides, be carried well away to sea and not coast along any neighbouring shores, **very careful and complete float-observations** must be carried out under all possible conditions of wind and tide. These observations must not only be made with surface-floats, but also with submerged floats at different levels, and the various tracks or courses which these floats take must be followed and marked upon proper charts. When the most suitable spot has been thus determined, it may be found that even then it will not be safe to allow the sewage to flow continuously, but that it must be stored in tanks and only allowed to flow at some particular level of the ebb-tide. It is almost unnecessary to add that the culvert conveying the sewage to the submerged point of outlet must cause no obstruction to the navigation along the shore, and that it must be so marked with buoys or "perches", or be so visible both by night as well as day if necessary, that no accident to boats or shipping will occur.

It is no part of this article to enter into any details of engineering construction, but it may be well to give the following description of **the outfall works at Portsmouth**, as they afford an excellent example of a well-designed and carefully-constructed sea-outfall, carried out under the conditions which have been enumerated. The daily dry-weather flow of the sewage of Portsmouth was about 4,500,000 gallons when these works were carried out. The surrounding district is very flat, and for some miles the land only reaches a height of a few feet above the high-water mark of spring-tides. The sewage therefore has to be pumped. The Isle of Wight is opposite, and there is no promontory along the coast near to Portsmouth which could be selected for a suitable outfall. A reference to the plan (fig. 424), however, will show that there is a large land-locked harbour, called Langstone, situated about two miles to the east of Portsmouth, which at high water is filled with an enormous volume of water, and this water, as the tide falls, rushes through the narrow channel communicating with the sea; this narrow channel naturally suggested itself as a suitable locality for the outfall. Numerous and extended float-observations confirmed this opinion, as it was found that floats of all descriptions were without exception carried well away

to sea, if placed at this point *about one hour after the flood-tide had turned.* The plan clearly shows the value of these float-observations, as not only was a

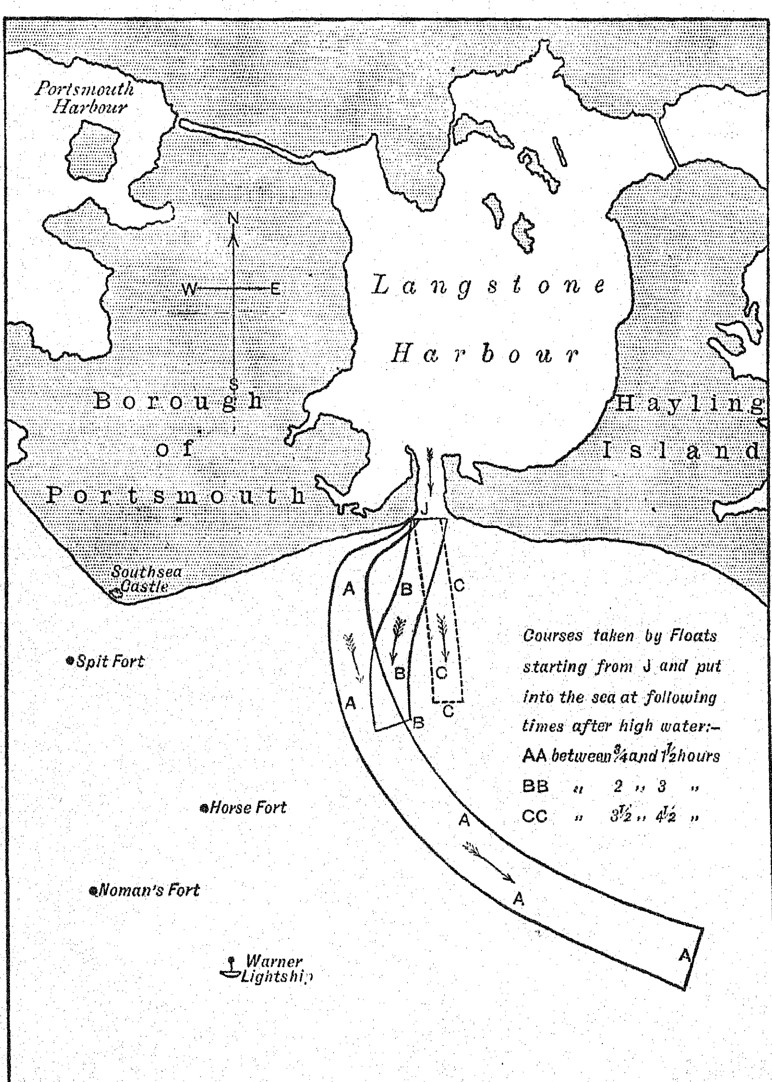


Fig. 424.—Borough of Portsmouth: Sewage-outfall Works. Plan showing float-observations taken from the outfall.

most suitable position for the outfall determined, but also the most suitable times of tide for releasing the sewage were also ascertained.

The sewage is raised at a pumping-station about a mile from the outfall, and forced along iron rising-mains to tanks close to the point of outfall. There are three of these tanks placed side by side, with a collective capacity of 4,500,000 gallons, and covering an area of $3\frac{1}{4}$ acres. Each tank is 160 feet in length and 150 feet in breadth, constructed of cement-concrete. They are arched over and

covered with soil and grass. The inverts are segmental in cross section, with a longitudinal fall of 1 in 150 to the outlets. In order to allow the whole of the contents to be discharged within about an hour and a half of high water, the level of the inverts has been placed one foot below ordinary high-water mark.

The quick discharge of the contents of these tanks is a special feature of the scheme, as it has to be accomplished in about three-quarters of an hour. The tanks first discharge into a culvert, seven feet by six in size, from which three lines of cast-iron pipes three feet six inches in diameter are carried well into the tide-way, their mouths being just below low-water mark.

The arrangement by which the large penstocks, which let the sewage from the tanks to the culvert, are opened, is very ingenious. At the moment when the discharge ought to take place, a man opens a small penstock from the top of the tank, the escaping sewage from which operates a turbine, which sets in motion the machinery by which the large and heavy penstocks are opened, thus liberating the sewage in large volume, and with a very small expenditure of time and labour. These works and outfall have been in successful operation for the past eight years, and no nuisance or trouble of any kind has been occasioned thereby. They were designed and carried out by the late Sir Frederick Bramwell and Mr. Graham Harris, and are the best example of a successful sea-outfall with which the author is acquainted.

An outfall into an estuary may also be successfully carried out, where the volume of water passing out to sea is very largely in excess of the quantity of sewage poured into it, and where from its velocity the sewage will be carried well past the shores and away to sea, and where no obstructive banks or bars will be formed by the detritus or heavier particles in the sewage settling on the bottom, and thus perhaps causing serious obstruction to navigation or impediment to the flow of water.

There are many instances of successful sewage-disposal into estuaries, the most notable being that of Liverpool, which pours nearly the whole of its sewage in a crude state into the river Mersey. The dry-weather flow of this sewage amounts to about 10 million gallons in twenty-four hours, but owing to the large volume of water entering the Mersey at each tide, and the quick velocity of the flow of the ebb-tide, no trouble has ever occurred during the great number of years this method of disposal has been practised. There are twelve outfalls of various sizes discharging their contents below low-water mark, and though the outfalls are in many cases close to the entrances of docks, no nuisance whatever has arisen.

Outfall into a river is to be deprecated except under very exceptional cir-

cumstances, such as when the river consists of a very large volume of water, and where the water below the outfall is not used for domestic purposes. Unfortunately, owing to the facilities and economy of thus disposing of sewage, it was almost universally the practice throughout this country when sewers first came into vogue, but the effects produced on the rivers, and even on the health of the inhabitants in their vicinity, were so disastrous that steps were very early taken to prevent or mitigate the nuisance thus caused, and the whole question as to the proper disposal of sewage thus began to be discussed. Unfortunately there are still many cases of river-pollution in this country by sewage and manufacturers' wastes, and the condition of many of the rivers and streams in this country is a disgrace to the Local Authorities who are responsible for their condition.

The Public Health Act (1848) did not deal with the question of **the pollution of rivers,** nor did the great Public Health Act (1875), as these acts were permissive rather than compulsory, and even the Rivers Pollution Prevention Act (1876) entirely failed in its object. The Local Government Act of 1888, which gives certain powers to County Councils to enforce the provisions of the Rivers Pollution Prevention Act, has, however, led to something being done to remedy the great evils at present existing. It is to be hoped that the Royal Commission on Sewage Disposal, which is now sitting, may be the means of clearing the tangle into which this question has drifted, and that efficient legislation may follow its conclusions when the final report is issued.

Fortunately for us, Nature herself provides her own self-cleansing powers, or we should all soon suffer from our negligent uncleanliness. The action of the oxygen of the air and in the water, the absorption of organic impurities by plants, and, above all, the myriads of bacteria to which the processes of putrefaction and nitrification are due, are constantly at work purifying our polluted rivers, and rendering them again fit for the use of man; but there can be no doubt that the practice of turning our waste products into rivers—and particularly small rivers and streams—is to be greatly deprecated, as numerous cases are on record where the germs of typhoid fever have been carried in rivers for long distances, and have led to outbreaks of the disease in places many miles away, where the water has been drunk. The only safe course is to adopt some method of purification on the lines hereafter laid down.

CHAPTER III.

TREATMENT OF SEWAGE WITH VARIOUS CHEMICALS.

The evils arising from the introduction of drains and sewers in place of the old middens and cess-pits, and the desire to prevent the waste of what was then considered to be a valuable manurial product, many years ago induced chemists and other scientific men to attempt to discover a universally satisfactory method of sewage-disposal. Many and various were the remedies suggested, and much time and a great deal of money were expended in the endeavour to find some method which would stop decomposition, and by the aid of chemicals remove or render harmless all the organic matter and dangerous organisms contained in sewage, arrest whatever was of manurial value, throw down all the matters in suspension, and at the same time allow the effluent water to escape in a wholesome condition. This was the problem, and up to the present time no thoroughly satisfactory solution has been found by which this can be effected by chemicals. It would be very interesting, did space permit, to recount the various systems of deodorization, antiseptic treatment, and precipitation, which sprang into existence and lived for longer or shorter periods, but this would not serve any very useful purpose, and the following short list and description will suffice.

1. **Sillars's "A.B.C. Process"** of dealing with sewage found considerable favour at one time, and derived its name from the ingredients which were used for the purpose of precipitating the solids and purifying the effluent of the sewage in tanks. These ingredients consisted of alum, blood, charcoal, clay, magnesia, and other compounds, some of which were afterwards found to be unnecessary. Although considerable purification of the sewage took place, the amount of sludge left in the tanks proved to be a stumbling-block, and the sale of this material was difficult. This process, with modifications, is still in use at the Sewage Disposal Works at Kingston-on-Thames, and it is claimed for it that less tank capacity is required, that the tank effluent is greatly purified, and that this effluent can consequently be more easily dealt with on land or by artificial filtration. The sludge produced by this treatment has considerable market value as a manure.

2. **Lime Treatment.**—There are still many Sewage Disposal Works where lime is added for purposes of precipitation in tanks, though this method is being in turn superseded by treatment with alumino-ferric. Only the purest lime should be used, and this must be thoroughly slaked before being added to the sewage. It is nearly always used in the form of milk of lime, the average dose

seldom exceeding 1 ton of lime to each million gallons of sewage treated. Thorough mixing of the lime and sewage is essential, and there are several methods for effecting this. There should also be sufficient tank capacity to ensure a proper deposition of the solid matters in suspension.

3. **Alumino-ferric,**[1] or sulphate of alumina and iron, is very usually employed

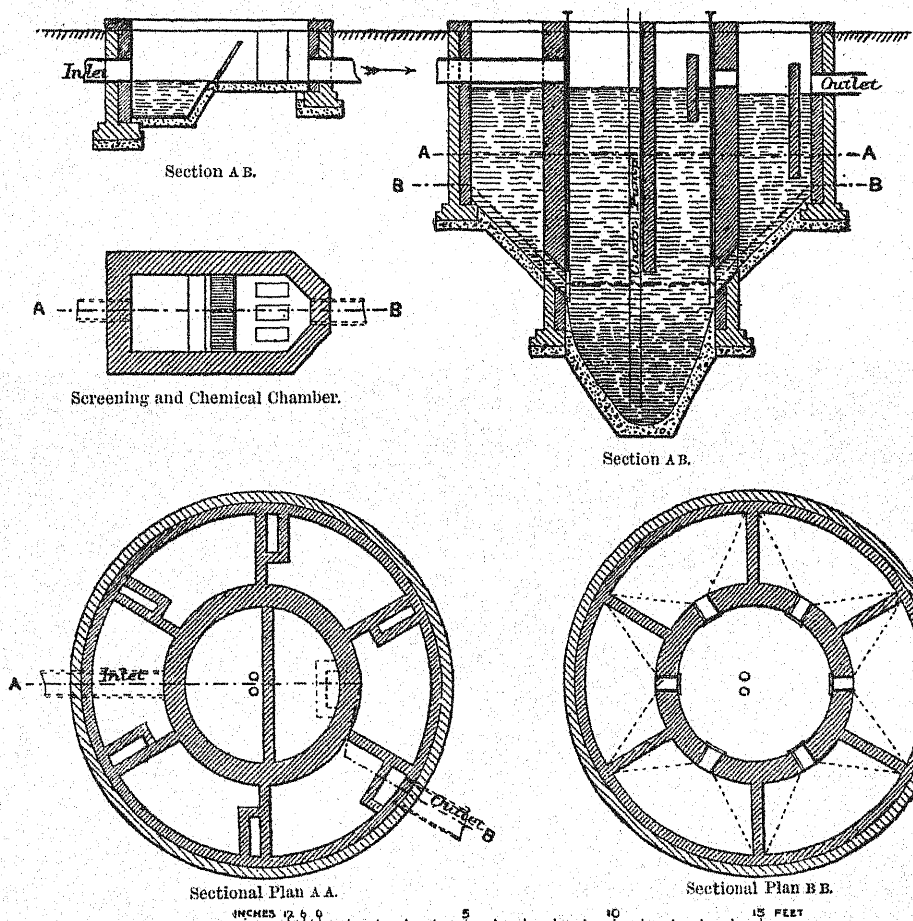


Fig. 425.—Cosham's Sewage-precipitation Tank, with Screening and Chemical Chamber.

where chemical treatment is resorted to, as it can be obtained in solid cakes, which can be placed in the channel carrying the crude sewage, where the cakes gradually dissolve, and thus the material is easily mixed in proper quantity with the sewage.

4. **The Amines Process** was introduced some years ago by Dr. Wollheim, and consisted in the addition of ordinary herring-brine to the lime. A soluble gas

[1] Alumino-ferric is said to be composed as follows:—Soluble alumina, 14·00 parts; peroxide of iron, ·75 part; sulphuric acid, 33·81 parts; water, 51·44 parts; total, 100·00 parts.

was said to be produced, which acted as a "germicide", but the process has not met with the success that was at one time anticipated.

5. **Cosham's System** claimed to effect a more perfect purification of the sewage by prolonging the period during which contact is maintained between the chemical introduced into the sewage (preferably alumino ferric) and the sewage. The special construction of tank required in this process is shown in fig. 425. The chambers in these tanks are said to arrest in a remarkable manner the albuminoids and flocculent matters in the sewage.

6. **The Hermite Process** consisted in the electrolysis of salt water by electric currents, thus producing chlorine, which was added to the sewage in the drains or sewers. It is claimed that the sewage thus treated arrived at the outfall in a perfectly inoffensive condition. It was also stated that the engine and dynamo power required to produce sufficient chlorine to purify about 1,500,000 gallons of sewage is only about 100 horse-power, working continuously for ten hours. There can be no doubt that under certain conditions, and to meet special cases, some such process has considerable merits.

The difficulties and objections to be met with in dealing with sewage by chemical processes may be summed up as follows:—

(1) The varying character of the sewage to be dealt with, not only in different towns but also almost hourly during each day, this being intensified where, as in most cases, the sewage contains trade refuse or wastes, which are often very refractory under the influence of the chemicals used for the treatment of the sewage.

(2) The tendency of all chemically-treated effluents to revert to decomposition, this having only been temporarily arrested by the treatment.

(3) The first cost of the necessary works and plant, and the subsequent expense of treatment.

(4) The disposal of the sludge which is precipitated to the bottom of the tanks.

CHAPTER IV.

THE DISPOSAL OF SEWAGE SLUDGE.

A residuum which is technically known as "sludge" remains, as already stated, in all sewage-settling tanks after chemical treatment, and the ultimate disposal of this offensive, slimy semi-fluid material is by no means an easy matter. The amount of sludge produced from a given quantity of sewage

is naturally very varied, according to the quality or consistency of the sewage and the description and amount of the chemicals used in the process. For instance, it appears that the amount of sludge produced daily at Birmingham from the sewage of a thousand persons is nearly a ton (a cubic yard of sludge weighs about 16 cwts.), whereas, for the same number of persons at Chiswick, the amount of sludge is about a ton and a half, and at Leeds only a third of a ton.

The manurial value of sludge in its crude state is negligible, owing to the excess of water it contains (about 95 per cent), but when dried it is said to be worth about as much as ordinary farmyard manure, weight for weight; consequently all serious attempts to deal with this material have been in the direction of eliminating as much of the moisture as possible.

At some sewage works the preliminary step in the separation of the liquid consists in running the sludge upon **roughly-contrived filter-beds,** composed of ashes screened from ordinary house-refuse; after a partial drying the sludge is mixed with more ashes, and when sufficiently hard and dry this "compost", as it is called, is carted on to the land and dug in as manure. This method is, however, very tedious, as in damp or wet weather the drying by evaporation is much retarded, and the handling and cartage also become expensive items.

At Ealing, near London, the sludge is mixed with the house-refuse and **burnt in an ordinary destructor,** the residuum being an innocuous and inoffensive "clinker". This method was also adopted at Salford, but the process is liable to produce offensive fumes, which must be specially dealt with.

At the Birmingham sewage-farm the sludge is simply **dug into the land,** whilst at Crossness on the Thames, where a large proportion of the London sewage is dealt with, the sludge after a partial natural drying is pumped into special hopper steamships and **carried out to sea,** where it is discharged into deep water; this latter method has also now been adopted at Salford.

The more modern method, however, of dealing with this necessary evil of all chemically-treated sewage, is to **pass it through a "filter-press".** The plant necessary in this case is a steam or other engine, working an air-compressor of such capacity as will compress the required amount of air to a pressure of about 100 lbs. on the square inch. The filter-press is usually made of vertical cast-iron plates, with recesses on each face and projecting rims, so that when pressed together there is a space between. The surface of each plate is furnished with cloths of jute, hemp, canvas, felt, or some such material, acting as a straining medium.

Fig. 426 shows the general appearance of a filtering-press of the pattern supplied by Messrs. Manlove & Alliott of Nottingham. The sludge is forced through the centre of the fixed end into the chambers between the plates, where the pressure is maintained until nearly the whole of the moisture has been forced through the filtering-pads and flows out by openings at the lower edge of the plates. When water ceases to flow, the hand-wheels are loosened, and the end frame is moved by the piston acted on by the compressed air, and the plates are separated one from the other by sliding them along horizontal shafts. The sewage-cakes, which have thus been formed between the pairs of plates, drop out, as the plates are moved, into a truck or other receptacle placed under the

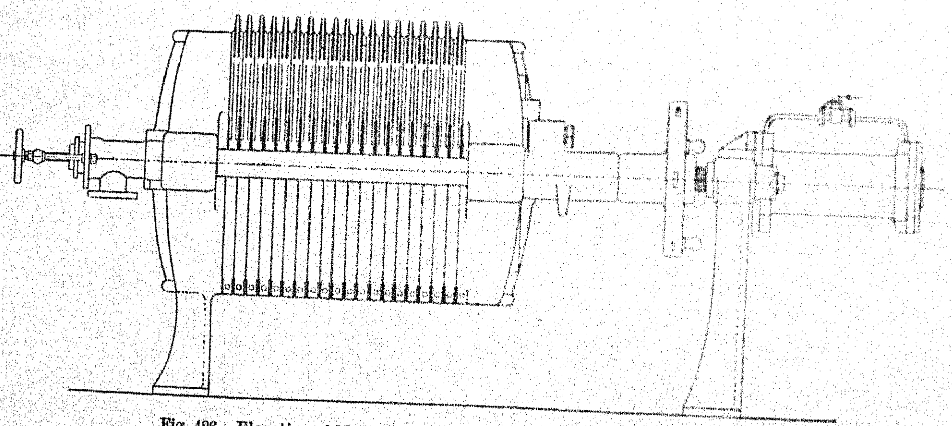


Fig. 426.—Elevation of Manlove and Alliott's Filter-press for Sewage Sludge.

press, and are removed to a suitable shed for sale as manure. The press is again closed, and the process of pressing resumed. Such a press as has been described is capable of turning out from 20 to 25 tons of cake per diem, at a cost of about 10*d.* per ton, the cake containing only about 50 per cent of moisture. About 5 tons of sludge can be pressed into one ton of cake, and this if dried and pulverized can be sold for about 2*s.* per ton. These figures will of course vary with the description of sewage dealt with and the chemicals employed, but it may be well to point out that it is generally found necessary to add from 3 to 5 per cent of lime to the sludge before pressing it, in order to prevent subsequent decomposition.

There is no doubt that sludge is the *bête noire* of all sewage-precipitation systems, and that very great difficulties are met with in storing and disposing of the mass of sludge which is made at all such sewage-disposal works.

CHAPTER V.

FILTRATION THROUGH LAND AND BROAD IRRIGATION.

Many were the early efforts to purify sewage by passing it through **mechanical filters,** either stationary, joggling, or rotating, but all these attempts, it is needless to state, were entirely unsuccessful, and experience has shown that it is impossible to filter sewage artificially, except through land or carefully-prepared bed-filters of suitable materials, and even then it is necessary to deal first with the sewage by some chemical or other process, in order to get rid of the sludge before reaching the filter, as otherwise this is soon choked and rendered inoperative.

It is true, however, that partially-successful purification of crude sewage has been obtained by what is known as **Intermittent Downward Filtration,** where a sufficient amount of suitable light land has been employed, but, in such a case, the treatment may be compared to broad irrigation. The land, however, in the former case is usually drained to a greater depth (6 or 8 feet), the drains are more frequent, and the soil (which must be of an exceptionally light nature) well broken up to receive the sewage. Where a large quantity of sewage has to be dealt with, in some cases equivalent to the sewage of a thousand persons per acre,[1] the land is not cropped, and the surface is frequently turned over in order to revivify it. No successful downward filtration of sewage through land or other materials can take place, however, unless the filtering medium is allowed to rest at intervals, in order that air, the great restorer, may enter the pores, and oxidize or burn up the organisms which have been at work eating up and destroying the organic matters in the sewage; and very little successful purification can take place, unless the sewage has previously been deprived of its heavier and slimy ingredients by some chemical or other precipitation process, as otherwise the sludge will eventually choke not only the surface of the filter, but sometimes even the interstices, and thus render the filter totally inefficient.

In some cases the surface of the land is formed into two or more series of narrow ridges and furrows, and by means of penstocks or syphons the sewage can be turned into the different series in succession. If osiers are planted on the ridges, a considerable quantity of sewage is absorbed by them.

[1] The eminent engineer, the late Mr. Mansergh, stated that no more than the sewage of 700 persons should be put upon 1 acre of land drained 6 feet deep. (Vide *Minutes of Proceedings of the Institution of Civil Engineers*, vol. xlix. p. 190.)

Dr. Frankland, in the First Report of the Rivers Pollution Commission, says, with regard to the filtering power of soils: "These results show how rapidly the process of nitrification (the conversion of ammonia and animal organic matter into nitrates) takes place in the Beddington soil, and how satisfactorily the sewage is purified, even at the rate of 7·6 gallons per cubic yard of soil per diem. But when this rate was doubled, the nitrification ceased, and the pores of the soil became blocked up, so that they would no longer transmit the whole volume of sewage applied and also afford time for aëration."

The limits of this article will not permit any further reference to intermittent downward filtration through natural soils; suffice it to say that good results can be obtained if the sludge is first removed from the sewage, and time is given to thoroughly aërate the soil before a fresh application of sewage is made. Dr. Voelcker says: "A well-drained and fully-aërated soil burnt up, or, in chemical language, oxidized most perfectly, the putrescible and nitrogenous organic constituents of sewage, and transposed them into nitrates and other final products of the decomposition of animal refuse matters, products having no smell, colour, or injurious properties".[1]

The disposal of sewage by **Broad Irrigation**, so called to distinguish it from Intermittent Filtration, still finds considerable favour with a great number of sanitarians, on the reasonable grounds that what is taken off the land ought to be put back on it, and that nature demands such a "circle of events". There can be no doubt that, theoretically, it is quite right that there should be no waste, and consequently the cry of "our sewage to the land or there will some day be no bread or meat" has much to commend it. Unfortunately the tendency of all civilized nations to congregate together in large centres makes it difficult to carry this worthy object into effect, and the difficulty of securing suitable and sufficient land within a reasonable distance of any large town or city makes it in most cases almost impossible, except at prohibitive cost, to dispose of the sewage by broad irrigation. The enormous bulk of sewage which has to be treated, its low manurial value owing to its dilution with water, its varying quantity with changes of the weather, and its unceasing flow day and night and at all seasons of the year, tend to complicate the problem of sewage-farming to such an extent as to make this method of dealing with sewage very unpopular except under exceptional circumstances. So far as experience can at present enlighten us, it is evident that commercially-successful sewage-farming is unknown, and that it is difficult enough, even under the most favourable circumstances, to deal with large quantities of sewage, especially during rain-storms,

[1] Vide *Minutes of Proceedings of the Institution of Civil Engineers*, vol. xlix. p. 191.

upon sewage-farms in a satisfactory manner, so as to secure an effluent which will not pollute in some measure the stream or river into which it flows. Dr. Lissauer after many experiments says: "The effluent water of irrigation-works ought not to be compared with good drinking-water, since it must nearly always contain some ammonia, often nitrates and nitrites, and always a certain amount of chlorine, which is almost completely unabsorbed by the soil".[1]

No doubt there are many instances **where there is sufficient land** available to so manipulate the sewage that portions of the land may be given intervals of rest, which revivifies them in such a manner that a very high standard of purity of effluent can be maintained, but these are fortunate circumstances not enjoyed by the majority of sewage-farms.

No hard-and-fast lines can be laid down as to **the quantity of land** necessary to ensure a successful sewage-farm. Much depends upon the character of the soil, whether light and loamy, or heavy and composed of clay. Much, too, depends upon the manner in which the farm is levelled, laid out, and drained. Much depends upon the climatic influences, and upon the quantity and quality of the sewage.

At Altrincham the sewage from a population of some 10,000 persons was dealt with on 10 acres of land for some months, and for many years the sewage of 11,000 persons was successfully dealt with upon only 47 acres of land. At Abingdon, 20 acres receive the sewage from 10,000 persons, and this form of sewage-treatment is still to the front. At the sewage-farm at Clichy, where the sewage of Paris is dealt with, about 9 million gallons of sewage per acre per annum are successfully dealt with, and in one case 35 million gallons were dealt with on one acre of land in two months.[2]

The following table shows very approximately **the amount of sewage** which was dealt with upon various sewage-farms, but these amounts are of course largely varied in times of heavy rain, and many of these places have since altered the treatment of their sewage to some form of bacterial treatment, which has within the last few years made enormous strides, and bids fair to supplant all other methods of sewage purification.

[1] Vide *Minutes of Proceedings of the Institution of Civil Engineers*, vol. lxvii. p. 356.
[2] *Ibid*, vol. xxxix. p. 380.

TABLE XXVI.

NUMBER OF GALLONS OF SEWAGE DEALT WITH PER DIEM ON VARIOUS SEWAGE-FARMS, PER ACRE.

Name of Place.	Gallons of Sewage dealt with in 24 hours per acre.	Nature of Soil.
Abingdon, ...	5,000	Loam.
Edinburgh, ...	10,000	Subsoil of sea-sand.
Banbury, ...	2,300	Stiff loam upon clay subsoil.
Cheltenham, ...	2,760	Clay.
Bedford, ...	4,516	Rich loam with gravelly subsoil.
Blackburn, ...	16,000	Light loamy soil upon gravelly subsoil.
Chorley, ...	5,747	Poor vegetable soil with stiff clay subsoil.
Doncaster	5,217	Light sandy soil.
Leamington, ...	2,950	Fine loam on gravelly subsoil.
Merthyr-Tydfil, ..	14,000	Fine loamy soil with gravelly subsoil.
Rugby, ...	6,153	Gravelly soil upon clay subsoil.
Tunbridge Wells, ...	3,000	Stiff loam and light subsoil.
Warwick, ...	5,185	Stiff clay.
Slough, ...	3,047	Sharp gravel and sand.
Barnsley, ...	16,886	Loam.
Aldershot, ...	1,960	Sand.
Croydon, ...	11,540	Open soil upon gravelly subsoil.
Berlin, ...	3,116	Sandy soil.

Professor Robinson says[1] that **the average cost of treating sewage on land,** at 26 sewage-farms examined by him, was 1*s.* 10½*d.* per head of the population, or about £7, 14s. 4½*d.* per million gallons of sewage.

The important points to be considered, in dealing with sewage upon the broad irrigation principle, are as follows:—

The position of the land with regard to the town, both as to locality and surroundings, and also its level, so as to avoid if possible lifting the sewage; the first cost of the land, and whether it is of suitable soil; the cost of the preparation of the land with regard to levelling, draining, and carrying the sewage to all parts of it—it is of the greatest importance that these should be carried out with great skill and perfection, as upon them, other considerations being equal, it depends whether the sewage can be properly purified or not; the choice of suitable crops and their rotation, and also whether there is a convenient market for the disposal of the produce. If there are no means of diverting the storm-water from the farm, very special means must be taken for dealing with it, as otherwise the land is overflooded at the very time when it is in a wet condition, and consequently in the worst position to receive so much liquid.

[1] Vide *Minutes of Proceedings of the Institution of Civil Engineers*, vol. xlix. p. 184.

There should be sufficient land, so that the various plots can be rested, not only when the crops are in a certain condition of growth, but also that the land may be revivified by the oxygen of the air, which is so important in all forms of sewage treatment.

The limits of this article prevent any discussion as to whether the produce grown on a sewage-farm, or the animals that feed on its produce, are injuriously affected by any pathological process. Suffice it to say that all attempts to prove any such injurious effects have hitherto failed, and that, with reasonable precautions and proper management, **a sewage-farm can be kept as healthy as any other farm.** Professor Forbes says: "There can be no question whatever but that, where the local circumstances of climate and soil are favourable to irrigation, and the conditions essential to its successful application properly observed, sewage irrigation is the most natural and effective system for the utilization of sewage, since it is only by this means that we can render available the whole of the ammoniacal salts, upon which so very much of the fertilizing value of the sewage depends".

There can be no doubt that the question of the disposal of the sewage of any town or building must be fully considered with all the surrounding circumstances, and each case requires careful and anxious enquiry and study before any decision can be arrived at. The sewage from a country house, for example, may be disposed of by the system of broad irrigation, if there is suitable land available at a sufficient distance from the house to prevent nuisance, but as a general rule it is better, even under these conditions, to run the sewage slowly through tanks before applying it to the land.

With reference to **the cropping of sewage-farms,** each case must be taken on its merits as regards suitability of soil, proximity to a town, climate, and other matters. There can be no doubt, however, that a sewage-farm properly managed produces most generous crops, as witness the following table of the results of a year's working of the Walton-on-the-Hill sewage-farm, which was under the control of the author, and which was well managed by the farm-bailiff in charge. The soil is a loamy clay, and the sewage was passed over the farm as it came from the sewers, without any chemical or other treatment. The main carriers were underground, and the greater portion of the farm was drained at a depth of about 5 feet, these drains converging into main effluent drains, which emptied into the river Alt. The effluent was free from solid matter, but did not reach the standard of purity required under the Rivers Pollution Acts, a fact which was not as important in this case as in others, as the waters of the Alt are not used in any way for domestic purposes.

TABLE XXVII.

WALTON-ON-THE-HILL SEWAGE-FARM—RETURN AS TO CROPS AND THEIR VALUE FOR THE YEAR 1896.

Plots.	Crop.	Acreage.	Quantity of Crop.	Average Price.	Gross Amount.	Per Acre. Quantity.	Per Acre. Value of Crop.
			Tons. cwts. qrs.		£ s. d.	Tons. cwts. qrs.	£ s. d.
1 & 3	Turnips,	$10\frac{1}{2}$	254 11 1	$10\frac{1}{4}d.$ per cwt.	217 2 8	24 6 2	21 3 8
11 & 12	Scotch Cabbage,	$13\frac{3}{4}$	5297 dozens	$10\frac{1}{4}d.$ per doz.	226 19 11	$385\frac{1}{4}$ doz.	39 17 6
			Tons. cwts. qrs.			Tons. cwts. qrs.	
„	Do.	„	263 9 2	9*d.* per cwt.	197 11 0	19 3 1	
15	Cabbage-Savoys,	$27\frac{3}{4}$	24 13 3	$8\frac{3}{4}d.$ „	18 4 11	0 17 3	
„	Do.	„	800 dozens	$7\frac{1}{4}d.$ „	23 14 2	$28\frac{3}{4}$ doz.	
„	Do. plants,	„	40,000	4*s.* per 1000	8 0 0	1441	16 7 9
			Tons. cwts. qrs.			Tons. cwts. qrs.	
„	Rye Grass,	„	655 16 3	$7\frac{1}{4}d.$ per cwt.	404 16 1	23 12 2	
6	Do.	$6\frac{1}{4}$	280 12 1	$6\frac{3}{4}d.$ „	160 14 0	44 18 0	25 14 3
4	Rye Grass and Oats,	$6\frac{1}{4}$	234 18 3	$6\frac{1}{4}d.$ „	129 10 5	37 11 3	20 14 6
5	Do.	$10\frac{1}{4}$	174 3 2	$5\frac{1}{2}d.$ „	82 14 5	16 19 3	8 1 5
10	Do.	$14\frac{1}{2}$	581 3 0	$6\frac{1}{2}d.$ „	316 13 6	40 1 2	21 16 10

CHAPTER VI.

THE SEPTIC OR BACTERIAL SYSTEM.

Until recently **the processes by which decaying animal matter gradually disappears** were little known and less understood. It was known that chemical changes occurred, but how or why was beyond the chemist's power to explain. It is now, however, recognized that many of the chemical changes which take place in organic matter are closely bound up with the life-history of the micro-organisms, either animal or vegetable, generally known as microbes. There is no doubt that the disappearance of solids from sewage passed into a stream is in great measure brought about by micro-organisms. These feed on the organic matter and excrete it in a new form, its chemical composition as a rule being rendered simpler by the change. As a general rule, each species of micro-organism is poisoned or killed off by its own products; but the life-products of one species will generally serve as food for another. The breaking down of the solids in sewage thus forms a long chain of operations, though often accomplished in a marvellously short space of time.

In the Septic or Bacterial System no chemicals are employed, and there is no "treatment" of the sewage in the ordinary sense of the term, its purification being accomplished entirely by natural agencies.

The original Septic Tank, as designed and described by Mr. Cameron, was merely a receptacle designed to favour the multiplication of micro-organisms, and bring the whole of the sewage under their influence. To this end the tank was constructed of ample size, though not larger than would be necessary with chemical precipitation, and covered so as to exclude light, and, as far as possible, air. The incoming sewage was delivered below the water-level; and the outlet also was submerged, with the twofold object of trapping out air and avoiding disturbance of the upper part of the contents of the tank. On entering the still water of the tank, the solids suspended in the sewage were to a great extent disengaged, going either to the bottom or to the surface, according to their specific gravity. In the absence of light and air, the organisms originally present in the sewage increased enormously, and rapidly attacked all the organic matter. By their action the more complex organic substances were converted into simpler compounds, and these in turn were reduced to still simpler forms, the ultimate products of the decomposition in the tank being water, ammonia, and carbonic acid and other gases. Mr. Cameron claimed that no sludge need be formed, and described the bacterial action as follows:—"The larger part of the solids in the tank are found at the top, where a somewhat tenacious scum soon forms, consisting of the lighter solids in process of decomposition. The intensity of the action going on is evidenced by the large bubbles of gas, which everywhere break through the scum. Here is probably the chief seat of the bacteriological action, by which the solids are eventually thrown into solution. As soon as most of the organic matter in a solid substance is dissolved, the ash falls to the bottom, where decomposition continues its work. Presently a bubble of gas is formed, which buoys a fragment of ash and brings it again to the under side of the scum. The bubble soon becomes disengaged, and the ash falls again to the bottom. There is thus a constant interchange between the upper and lower layers of the tank, whereby its solid contents are brought under the most favourable conditions for rapid decomposition and solution. After a tank has been a short time at work, the scum increases in thickness very slowly. In one case, after thirteen months' work, the scum was only a few inches thick."

The effluent from the septic tank was turned on to filters, or bacteria beds, in which the effluent was held up for a certain period of time. Mr. Cameron's automatic gear for effecting this is thus described:—"The supply of effluent to each filter, and the discharge of the clear water after filtration, are controlled by valves, all connected to one rocking shaft; the clear water from each filter passes into a bed of gravel underlying it, from which it is led by drains into a collecting-well; as the effluent fills the filter, the clear water rises in the collecting-well,

and when the filter becomes full, a small quantity of clear water overflows from the collecting-well into a bucket carried by the shaft; the water thus thrown into the bucket bears it down the rocking shaft, and thereby actuates all the valves; the flow of effluent to the filter already full is stopped, and its discharge-valve opened, the effluent being turned on to the empty filter, whose discharge-valve is at the same time shut down. The water, rushing out from the filter last in use, draws down after it through the filtering material the charge of air required for dealing with the next dose of effluent. When the bucket which rocks the shaft sinks into its lower position, its contents are discharged through a counterbalance chamber, in which a part of the water remains to hold the valves in place until the other filter shall be full. The overflow from this second filter passes into another bucket, which was raised into position by the sinking of the first, and by means of which the valves are brought back into their original position."

Fig. 427 shows **the general arrangements of this septic tank and of the filter-beds,** but it ought to be stated that simpler mechanism has now been devised for throwing the contact beds or filters alternately out of use.

The analysis of the effluent from the filter of one of these works as taken by Dr. Rideal, was as follows:—

TABLE XXVIII.

ANALYSIS OF EFFLUENT FROM CONTACT BED

	Parts per 100,000.
Total solids, ...	76·8
Mineral matter, ...	57·1
Organic loss on ignition, ...	19·7
Chlorine, ...	7·28
Nitrogen as nitrates, ...	3·72
Nitrites, ...	strong
Free ammonia, ...	0·0124
Albuminoid ammonia, ...	0·044
Oxygen consumed in four hours at 80° F., ...	0·324
Total organic nitrogen,[1]	0·066

Dr. Rideal, in a paper which he read before the Sanitary Institute in December, 1896, on "The Purification of Sewage by Bacteria", stated, in connection with Mr. Cameron's septic process, that radical changes take place in the tanks, produced by the bacteria which are present in the raw sewage, and whose growth is favoured by the absence of light, air, and comparative absence of movement.

[1] The Rivers Pollution Commissioners allow up to 0·3 organic nitrogen in an effluent passed into a river.

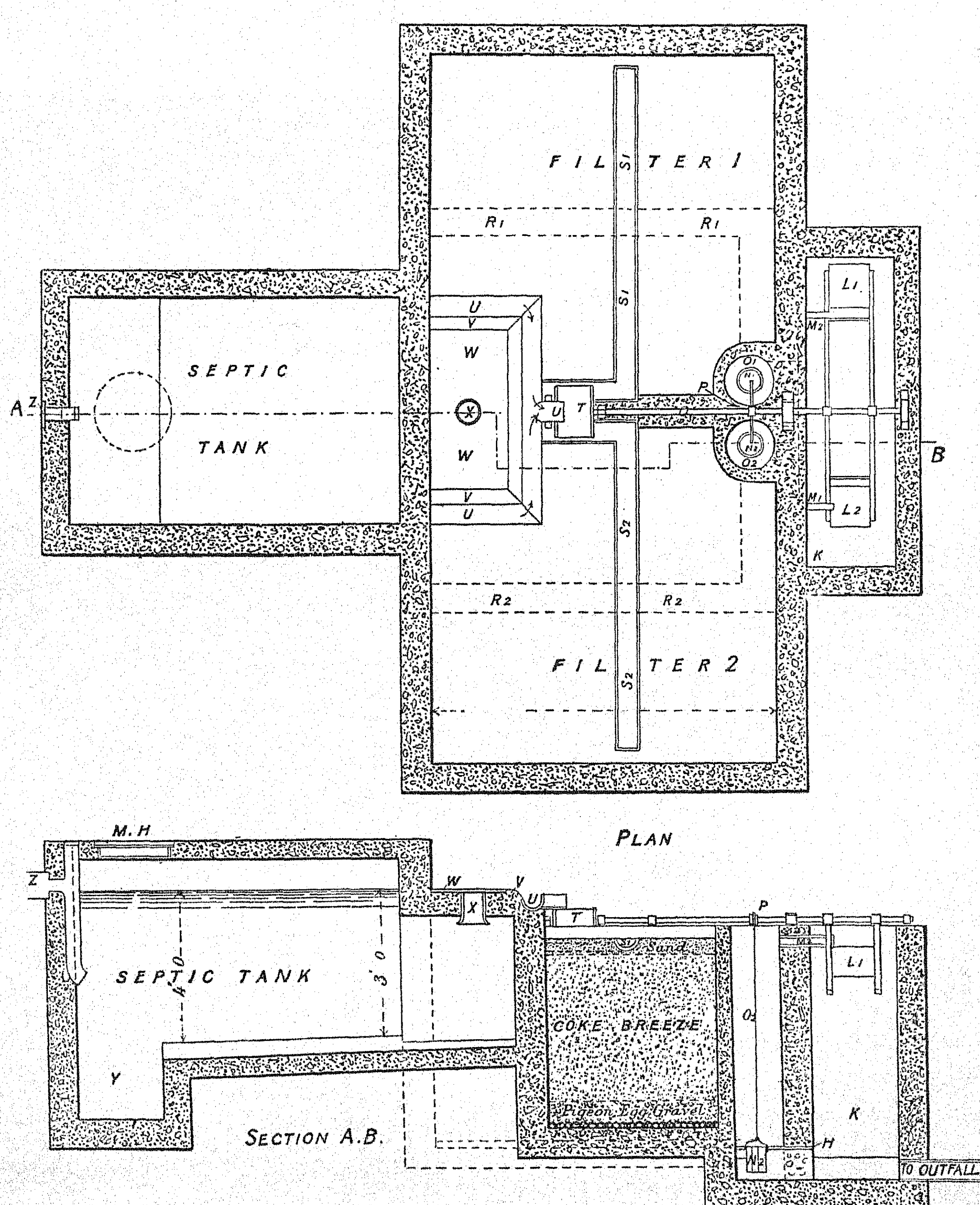


Fig. 427.—The Original Septic Tank System of Sewage Treatment.

Z. Inlet to septic tank. *Y.* Sump for grit. *X.* Outlet to septic tank. *W.* Table top. *V.* Weir. *U.* Channel pipe collecting effluent after passing over weir. *T.* Diverter. *S1, S2.* Channel pipe distributors over filters. *R1, R2.* Culverts at bottom of filters. *Q.* Shaft. *P.* Rocker. *O1, O2.* Wells for discharging valves. *N1, N2.* Discharging valves. *M1, M2.* Overflows from wells to actuating tanks. *L1, L2.* Actuating tanks. *K.* Well for actuating tanks. *H.* Cast-iron plate with seatings for valves *N.*

He summarized the results of a series of experimental analyses, which he had carried out, as follows:—

"(1) A marked increase in the total solids in solution or fine suspension.
(2) A reduction of about 33 per cent of the organic matter as measured by the oxygen consumed.
(3) An increase of about 33 per cent in the free ammonia.
(4) A reduction of about 54 per cent in the organic or albuminoid ammonia, or 50 per cent of the organic nitrogen.
(5) A slight production of oxidized nitrogen, and a disappearance of a small amount of the total nitrogen."

These changes are effected by means of the bacteria, enzymes, or spontaneous chemical decomposition in the tank, and Dr. Rideal was of opinion that the septic tank effected as much purification as an average chemical precipitation process, or as slow upward filtration, and "that the solid fæces and other matter in suspension pass into solution in the septic tank".

In the fifteen years that have elapsed since the "Cameron" experimental Septic Installation was constructed at Exeter, considerable developments have followed, but they are all practically on the same lines, viz., first a tank, covered or otherwise, and then bacteria beds or filters where the tank effluent is further treated. It will be well to endeavour to explain the process at more length, showing the various modifications and rules where possible.

The Tank.—The sewage flows into a tank which for convenience of cleansing should be divided into two or more compartments. The size of this tank should be such that its total working capacity should be equal to about one day's dry-weather flow.

The sewage should enter below the top of the sewage in the tank. The tank may be covered or not. Some experts advocate a covered tank as helping the anaerobic action which plays so important a part in this septic or liquefying tank; but it is doubtful if there is a great deal in this contention: anaerobic action appears to go on equally well in an uncovered as in a covered tank. Owing to this action, however, the contents of such a tank are very offensive, and if nuisance is to be avoided the tank should be covered. The depth of sewage in the tank is of some importance, as it should be sufficiently deep to avoid much disturbance of its contents when there is an extra rush of sewage, due to rain-storms or other causes. The effluent from the tank should be taken from below the surface in the same manner as the sewage enters the tank.

The next question is **the treatment of the effluent.** This is generally effected in one of the following manners:—

(*a*) By storage in **primary** and **secondary beds.**

(*b*) By passing it through **streaming** or **percolating filters.**

(*a*) In this case **contact beds** are constructed and filled with clinker, coke, broken stones, or other suitable material, in which the effluent is allowed to rest for a certain period, and where the aerobic action follows the anaerobic action of the tank.

The size, depth, and material of which these beds are formed are very various, and there is yet no universal custom. What is striven to be arrived at in their construction is that their cubical capacity shall be sufficient to ensure that every portion of the effluent shall come in contact with the greatest number of the aerobic or nitrifying germs contained in the bed. Whereas the size of the tank has been settled at a capacity equal to the dry-weather flow of one day's sewage, the capacity of those primary beds must be equal to three times this quantity, for reasons that need not be mentioned here. The depth of these beds should not be less than 3 feet, and perhaps not more than 6 feet, but, as has been already stated, experts disagree considerably on many of these points of detail.

The filling and emptying of these beds should, if possible, follow a cycle of the following kind:—

Filling	$1\frac{1}{2}$ hours.
Resting full	3 ,,
Emptying	$1\frac{1}{2}$,,
Resting empty	2 ,,

It is of the utmost importance that the bed should be thoroughly drained, no effluent being allowed to remain at the bottom of the bed.

From these primary beds the effluent is frequently further treated in **secondary contact beds,** the beds being similar in all respects to the primary beds, except as regards the size of the "filtering" media. The word "filtering" is generally used, though it appears to be somewhat of a misnomer; the author would suggest "bacterial" medium as being more appropriate.

Bacterial Media.—With regard to this medium, experts are again somewhat divided in their opinion, as to the best material to be employed and the sizes to which the material should be reduced. The consensus, however, of modern opinion appears to be that the material should be hard and free from dirt or dust, and that the size should be not smaller than that which will pass through a $\frac{1}{4}$-inch, or larger than that which will pass through a $\frac{3}{8}$-inch screen.

The cost of suitable material must be considered, so that the selection of such a material must be in a large measure dependent upon the locality. Amongst various materials which have been used for the purpose may be mentioned: coke, coal, clinker, engine ashes, saggars (from pottery works), slate (recommended by Dibdin), hard gravel, and granite. The material selected should be sufficiently hard not to disintegrate, and at the same time have sufficient cavities or small caves in which the countless colonies of bacteria may be housed.

With regard to **the capacity of these beds,** the liquid capacity is, roughly speaking, about one-third of the gross capacity, but as there is a cycle of three fillings in the twenty-four hours, the gross capacity of a bed represents its daily working capacity.

The proper working of the beds has to be regulated either by hand or by automatic machinery. There are a large number of ingenious arrangements by which automatic working is effected, but they all require somewhat skilled attention, without which they are liable to get out of order. Automatic syphons are often used for the purpose. The effluent syphon is placed in a small chamber, and its inlet arm is taken through the wall of the chamber to the bottom of the contact bed. A small pipe is also fixed through the wall of the chamber at a higher level, and on the end of this a cock is fixed; by means of the cock the flow of sewage into the chamber can be regulated to give the required period of rest to the sewage in the bed, as the syphon will not begin to empty the bed until the sewage in the chamber has reached a certain level. A number of syphons may be connected in such a way as to discharge a series of beds in rotation.

(*b*) **Streaming or Percolating Filters.**—In this case the tank effluent is not held up in a bacterial bed, but is allowed to stream continuously through the bed, which is composed of similar material to that of a contact bed. Here again experts are divided as to the depth necessary, and the means by which the effluent shall be applied to the bed so as to get the best possible result and purification. The earlier beds were made of considerable depth, in some cases as much as 12 feet, but modern practice tends to reduce this depth, and from 3 feet to 4 feet is now generally accepted as giving the best result. Dr. George Reid, who is a well-known expert on this question, has, however, from recent experiments, demonstrated that with a certain class of sewage and an excellent bacterial medium (viz. broken saggars), and with a tank effluent mechanically distributed thereon in the best manner possible, a very high standard of purity has been rendered by passing the tank-effluent

through only 1 foot 6 inches of the depth of a streaming filter. Whether this would be possible in all cases remains to be seen, but if so it will tend to further simplify the question of sewage purification and greatly reduce the cost. Various methods of distributing the tank-effluent on to the filter have been devised, the inventors thereof claiming that each of their methods is the best. Some are mechanically-driven spreaders, whilst others derive their motion from the head of the tank-effluent itself.

Where the filter is circular, the most common practice is to erect **a rotating sprinkler,** which acts under the well-known law of "action and reaction", the issue of the effluent from the nozzles in the spreading arms driving the spreader in the opposite direction. The objections to this method are:

(1) A sufficient head (about 2 feet) is required to drive the sprinkler, and this head cannot always be obtained.

(2) A high wind affects the rate of speed, or may entirely stop the spreader.

(3) The distribution is not very even or regular.

Consequently, **electrically-driven spreaders** for larger installations have been introduced with good results. One considerable advantage is that the bacteria beds may be constructed rectangular instead of circular; the spreader or distributor can also be retarded or accelerated according to the dose required, and the desired speed can be maintained without fluctuation.

Rate of Filtration.—As to the quantity of tank-effluent that can be put through a percolating bacteria bed, the Local Government Board have at present decided that this may be at the rate of 56 gallons per square yard of surface of bed per foot of depth, where the effluent can be further subjected to final land treatment, and only 28 gallons where the effluent has no final land treatment.

It may here be convenient to state the present **regulations of the Local Government Board** in connection with the disposal of sewage. In any sewage scheme the whole of the sewage up to six times the daily ascertained dry-weather flow (technically known as D.W.F.) must be taken to the sewage disposal works for treatment. Any excess of this amount due to abnormal rain-storms may be passed over fixed weirs into convenient water-courses or streams, as this excess is held to be sufficiently diluted to be practically fit to be so disposed of without treatment. This leaves six times the D.W.F. to be dealt with. Of this quantity, in the case of districts sewered under what is known as the "separate" system (*i.e.* where the rain-water from streets and roads and front roofs, &c., is taken into separate surface-water sewers), four times the D.W.F. must be specially treated as weak sewage, and two

times as foul sewage. Where the sewerage is on the "combined" system (*i.e.* where the rain-water enters the "foul" sewers), the division is three times the D.W.F. to be treated as weak sewage and three times as foul sewage. The method of separation at the disposal works must be by a fixed weir or weirs; no movable penstocks or other arrangements are allowed. The "weak" sewage may be dealt with on a special area of land, the amount of "weak" sewage allowed per square yard of this area depending upon the description of the subsoil, or it may be passed through special "filters" at the rate of 500 gallons per square yard, the filter being about 3 feet in depth. This leaves either three times or two times the D.W.F. to be treated as foul sewage as the case may be.

In addition to this, in many cases, there may be considerable quantities of "trade effluents" discharging into the sewers. Provision must be made for this by adding the ascertained daily normal flow of these trade wastes, plus one-tenth, to the quantity of sewage to be dealt with as foul sewage.

The Local Government Board have further decided as to the capacities of the various tanks and filters. The capacity of the special "excess" filter has been given, viz. 500 gallons per square yard. The tank capacity must be about one to one and a quarter times the D.W.F. The contact beds must be either three or two times the capacity of the D.W.F. plus the provision for trade effluents, if any. The streaming filters must be worked at a rate not exceeding 56 gallons per square yard per foot of depth where there is subsequent land treatment, or 28 gallons where there is no subsequent land treatment.

Whether the result of the labours of the Royal Commission on Sewage will render it necessary to alter these figures it is impossible to say, and whether the figures are too arbitrary, as some experts consider, is not for the author to say; but these figures have been arrived at after much careful consideration of all the circumstances, and where followed in the preparation of schemes, have been attended with success.

The author will not go into the rather technical question as to whether the present "bacterial" processes eliminate from the effluents those "colloidal" matters which are said to remain in many of the treated effluents, nor will he deal with the much discussed question as to whether in some cases it is better to treat the sewage chemically before bacterial treatment or not. It is perhaps sufficient to say that each case must be scientifically investigated before a scheme is designed, and that every year brings to light more improvements in this important question of the proper purification of our sewage. The

effluent obtained by a good bacterial system of treatment cannot safely be used as "drinking water", but as a general rule it is equal to the reasonable standard of purity demanded by the county councils or other bodies whose duty it is to prevent the pollution of our rivers.

CHAPTER VII.

SEWAGE-DISPOSAL FROM HOUSES NOT CONNECTED WITH ANY SEWERAGE-SYSTEM.

Having thus far dealt with the general question of the disposal of sewage, it is necessary to say a few words upon that very difficult problem of **the disposal of sewage from isolated houses,** which have not the advantage of being connected with any general system of sewerage. A number of the previous remarks will apply in considering this question, but, of course, unless the isolated house is a large establishment, such as an asylum, hospital, gaol, hotel, school, large mansion, or something of the kind, it would be an expensive if not an altogether unwarrantable proceeding to adopt a chemical precipitation process for dealing with the sewage; nor might it be possible, on the other hand, to find sufficient land to take the sewage on the irrigation or filtration system, although in some cases, even where there is but little available land, this latter method might be advantageously adopted, and the remarks in the preceding pages on these systems are worthy of attention in connection with this question. Let us, however, deal with the problem of the disposal of the sewage from an isolated cottage or small residence.

Hitherto the methods mostly adopted in connection with such houses have been either privy-middens or cesspools, as being the most convenient and least expensive methods for getting rid of the sewage-matters. With regard to the former method, all the necessary remarks will be made in the next chapter. The cesspool and other methods of dealing with liquid sewage will now be considered.

The cesspool has been found—and is still found—to be the most convenient method for disposing of the sewage from isolated establishments, but it is almost unnecessary to state that such an arrangement is barbarous and insanitary, where, as in the majority of cases, the cesspool is both badly situated and wretchedly constructed. Other books have dealt at length with the evils arising

from ill-designed and badly-situated cesspools, especially that delightful book on *Dangers to Health*, by T. Pridgin Teale, M.A., so that it is unnecessary to say more upon the subject, but rather to point out what considerations are necessary to mitigate as much as possible this, at present, requisite adjunct to many houses; and it will be the object of these pages to endeavour to point out some of the more modern methods for effecting this purpose.

The choice of position must be guided by the available land, the position of the house, the gradient of the land, and above all by the "dip" of the subsoil-strata and the position of the well or water-supply. If the cesspool is to be emptied by the local authority, it ought to be within reasonable distance of the road, and as far from the house as practicable, in order to render the operation of emptying as little of a nuisance as possible. Proximity to the road has the additional advantage that extensive reconstruction of the drains will not be required when the laying of a public sewer in the road has provided better means of disposal than those afforded by a cesspool. The minimum distance between a cesspool and a house or other building intended for human occupation is prescribed by the by-laws or regulations in many districts. In some old by-laws still in force the minimum distance is 30 feet, but as a rule it is now 50 or 60 feet, and in some towns 100 feet.

Having settled the position, it is necessary to consider **the size of the cesspool.** This will, of course, be governed by the daily quantity of the flow of the sewage, and the interval of time to be allowed between each cleansing of the cesspool. The quantity of the daily flow depends upon the number of persons inhabiting the house, and the water-supply. That great sanitarian, Dr. Edmund A. Parkes, in his *Manual of Practical Hygiene*, states that "in poor families who draw water from wells, I have found the amount to vary from 2 to 4 gallons per head, but then there was certainly not perfect cleanliness"; and further on he states, after quoting various authorities, "I believe we may safely estimate that for personal and domestic use, without baths, 12 gallons per head daily should be given as an usual minimum supply, and with baths and perfect cleanliness 16 gallons should be used. This makes no allowance for water-closets or for unavoidable waste."

These observations of Dr. Parkes perhaps do not hold good to the present day, as where a water-supply is laid on the daily quantity used may rise to 25 or 30 gallons per head per diem; but, as $6\frac{1}{4}$ gallons of sewage equal a cubic foot, the dimensions of the cesspool can be easily calculated, when we know the exact amount of daily flow from a given number of persons, and have decided how often the cesspool should be emptied. If any part of the rainfall enters the

drains, the calculations will be somewhat more complicated, but, for obvious reasons, it is always best to exclude rainwater from cesspools.[1] Authorities on this subject state that a cesspool should be emptied at least once a week, but, owing to the nuisance and expense of this operation, much longer intervals are allowed to elapse between the cleansings, and this is specially the case where there is (very improperly) an overflow from the cesspool into an adjoining ditch or stream, or where, as in the majority of cases, the cesspool is steined with open brick or stonework so as to allow the liquid contents to soak into and pollute the surrounding soil.

Having then settled the dimensions, it is necessary to design **the shape of the cesspool.** It is found geometrically that the largest area is obtained, with a given amount of material, by a circular chamber, and in addition to this such a shape has considerable resisting power, and, if properly designed, is more easily cleansed. Thus, for a simple cesspool, the design shown in No. 1, fig. 428, meets most of the requirements. In districts having a subsoil of dry chalk or gravel, or of impervious clay, the construction of a deep cesspool is not a difficult matter, but in water-logged ground the cost of such a cesspool would in many cases be prohibitive, and it is then better to build a shallow oblong tank in order to reduce the expense of pumping out the water during construction. The drains should also be laid as near the surface of the ground as possible, and as cast-iron pipes can safely be laid with flatter gradients and nearer the surface of the ground than stoneware pipes, the former may be used with advantage. The saving thus effected in the excavations for the drains and cesspools will go a long way towards paying for the extra cost of the metal pipes.

The construction of the cesspool is a matter of great importance. In order to make it water-tight, it is a good plan to excavate the ground sufficiently wide that the cesspool can be surrounded with at least 6 inches of well-puddled clay. It is almost unnecessary to say that it should have a foundation of Portland-cement concrete and be built of good hard bricks (better lined throughout with Staffordshire blue bricks), set in Portland-cement mortar. The walls and bottom are usually rendered with Portland-cement mortar. The top may be formed in the shape of an arch or dome with bricks in cement mortar, or if the cesspool is shallow and near the surface of the ground, it may be covered with concrete reinforced with steel and rendered on the upper surface with cement mortar. Every cesspool should be provided with a hermetically-closed iron cover for access for cleansing.

[1] For particulars of rainfall, see § III., "Water-Supply".

The ventilation of the cesspool is a matter of great importance. Nearly all by-laws now in force specify that a cast-iron or other approved ventilating pipe, not less than 4 inches in internal diameter, must be carried up from the cesspool to a height which will afford a safe outlet for foul air. In some cases the minimum height allowed is 10 feet above the ground. The open top of the

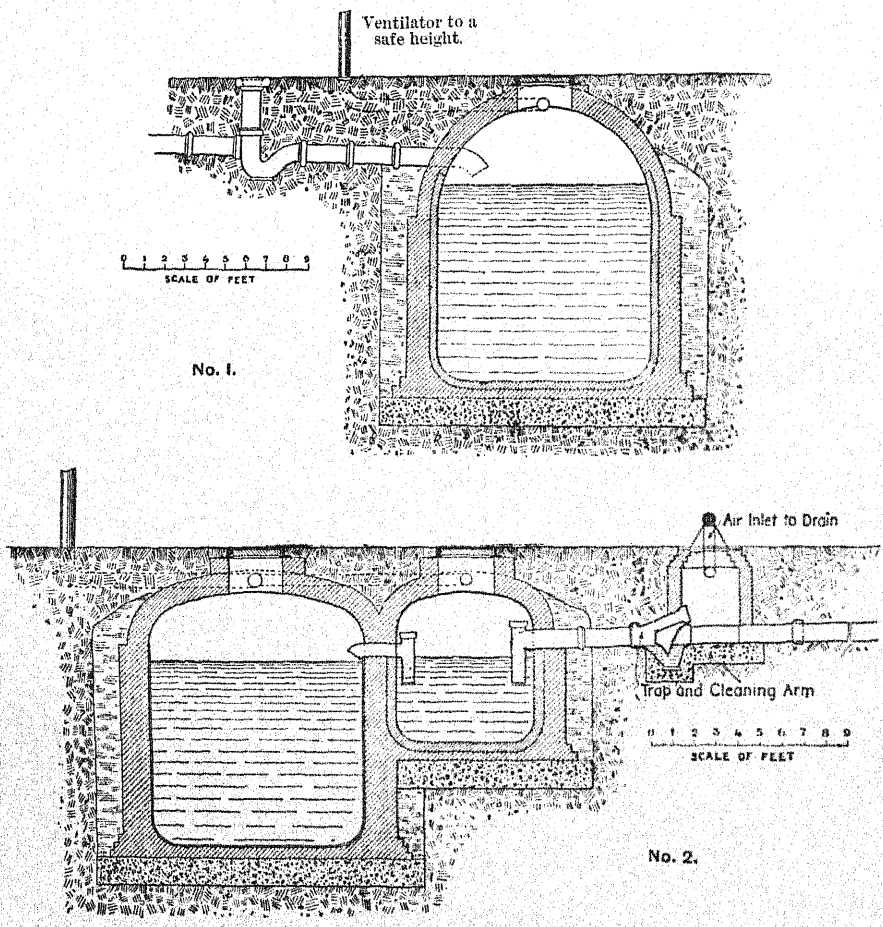


Fig. 428.—Sections of Single and Double Cesspools.

pipe should be protected by a balloon-shaped guard of copper wire to prevent the pipe from being choked with leaves, &c. The cesspools shown in fig. 428 are ventilated by vertical pipes of this kind.

The drain from the house should be trapped and ventilated near the cesspool, exactly in the same way as if the cesspool was a public sewer. The intercepting chamber shown in No. 2, fig. 428, is more convenient than the pipe shaft shown in No. 1, although the latter may safely be used for very shallow drains.

If there is no available land or other safe method for dealing with **the liquid overflow from the cesspool,** no overflow should be allowed, and the cesspool must be oftener cleansed. If, however, there is sufficient land, the overflow may be directed over alternate filter-beds of either gravel, suitable soil, or coke-breeze, in one of the ways to be described later. In this case, however, the cesspool serves the purpose of a septic tank, and must be of less capacity than an ordinary cesspool, and must indeed in all respects be

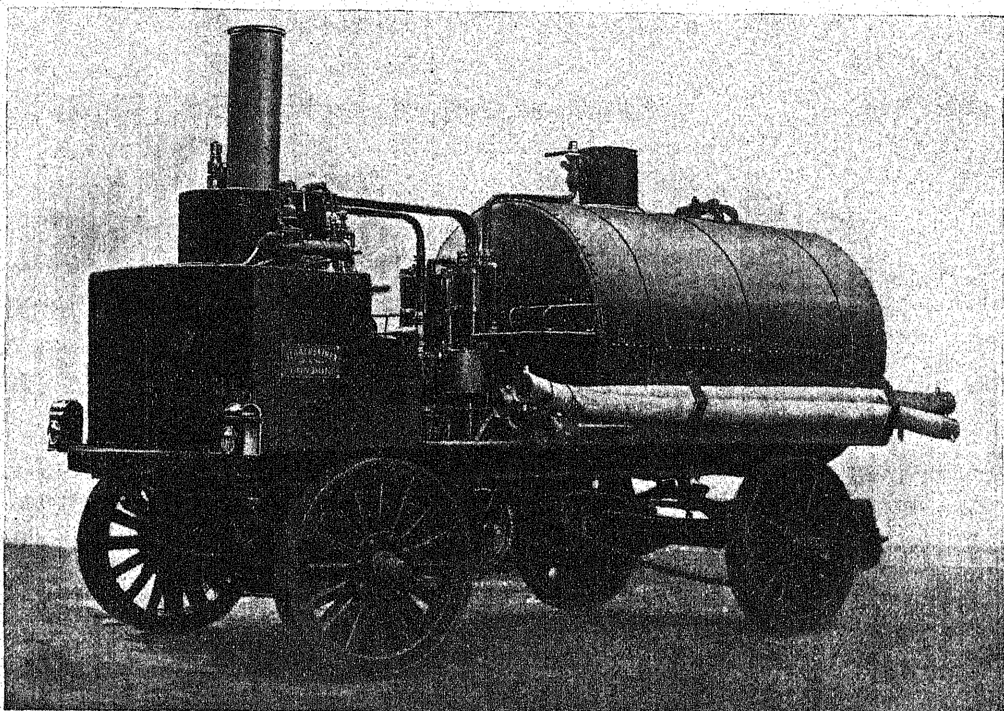


Fig. 429.—Merryweather's Pneumatic Cesspool-emptier.

designed and constructed as a septic tank. Where no overflow can be arranged, the cesspool would be better if constructed in duplicate, as shown in No. 2, fig. 428. The first compartment may with advantage be constructed as a septic tank to hold one day's flow of sewage, the inlet and overflow pipes being dipped as shown to prevent undue disturbance of the contents. Much of the solid matter present in the crude sewage will be broken up and liquefied or converted into gases in the first compartment, and the sewage in the second compartment can be pumped out and may on occasion be used with due care in the kitchen garden or on any other available land.

The cleansing of cesspools is always a disgusting and troublesome process, and is generally effected at night. It is usually done by hand labour, the

contents being taken out in buckets or pumped into carts or wagons, either open or covered, and carried off to be deposited on land or into pits, or otherwise dealt with. This method of emptying cesspools is essentially crude and unscientific, and a more modern method is that now adopted of employing a special vehicle for the purpose. The ordinary vehicle is drawn by a horse, and consists of an iron tank on wheels, from which the air is abstracted by a manual pump; a hose attached to the vehicle is inserted into the cesspool, a stop-cock on the hose is opened, and the tank is filled by the pressure of the atmosphere without causing the slightest nuisance. Messrs. Merryweather have designed a steam motor cesspool-exhauster, which is shown in fig. 429. The tank is exhausted of air till a vacuum of about 15 inches is reached, by means of powerful air pumps driven by the motor. The suction pipes, which are carried in brackets on the sides of the tank, are screwed to the rear valve and the end placed down the manhole of the cesspool. All connections being tight, the inlet valve is opened and the sewage is drawn into the tank. The air pumps are kept running during the operation, the exhaust air being sent through the furnace in the boiler to deodorize it. As soon as the cesspool is empty the inlet valve is again closed, and the machine travels forward to its next job.

A substitute for the country cesspool is often found in the disposal of the sewage on land. If agricultural land is not available, a plot of garden will suffice. It is not generally understood how small the plot may be. The area of ground generally accepted as sufficient for the purification of sewage by "Intermittent Downward Filtration", is one acre for the sewage of 700 to 1000 persons; a patch of garden 6 yards square will therefore suffice for the purification of the sewage from an ordinary household of five or six persons. The ground must, of course, be of a suitable nature and be suitably prepared. An interesting method of preparation is that adopted by Dr. G. V. Poore, and described by him in a paper on "The Treatment of Domestic Slop-water in Isolated Houses", read before the Sanitary Congress in Leeds in 1897. The "filtration-gutters", which he advocates, for the disposal of domestic slop-water, have been successful far beyond his expectations, and are constructed as follows:—

"A trench two feet deep and eighteen inches wide, and of a length varying with the circumstances, is dug and filled up with porous material, such as builders' rubbish, old crockery, and tins, stones, &c., to within a few inches of the surface, and upon this rubbish, previously rammed, walls of concrete or honeycomb brickwork are formed, provided with a ledge sufficiently wide to support a perforated tile, the perforations being big enough to admit a large-size knitting-needle, say one-eighth of an inch in diameter. The porous rubbish

reaches to within an inch of the underside of the tile, and the sides are planted. The gutter may, if necessary, be protected with a grating." The description will be better understood on reference to the plan, elevation, and section given in fig. 430. Dr. Poore says that the gutter may with great advantage be

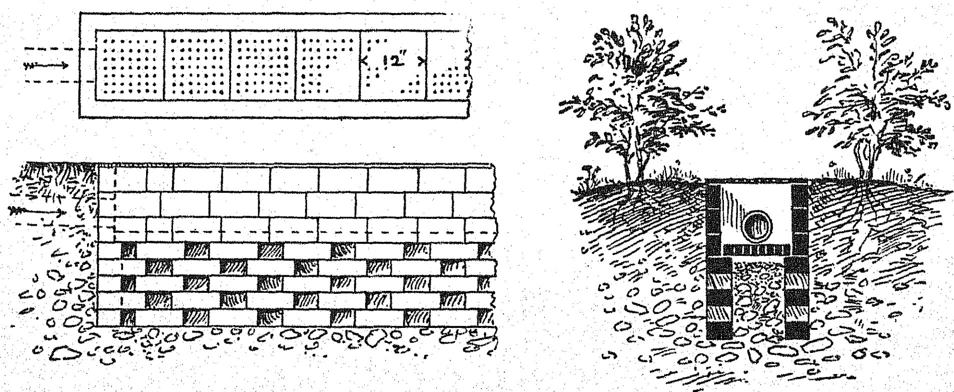


Fig. 430.—Plan, Section, and Elevation of Filtration-gutter.

placed upon a bank with gradually-sloping sides, as shown in fig. 431. This arrangement is "necessary on clay soils".

The perforated tiles forming the bottom of the gutter are those made for the floors of malt-kilns; they are an important part of the system, as they retain dead leaves and other rubbish and prevent them clogging the porous material below, besides breaking the force of the sewage, and so preventing "the downpour from the pipes from ploughing up the rubble, which is a most important matter".

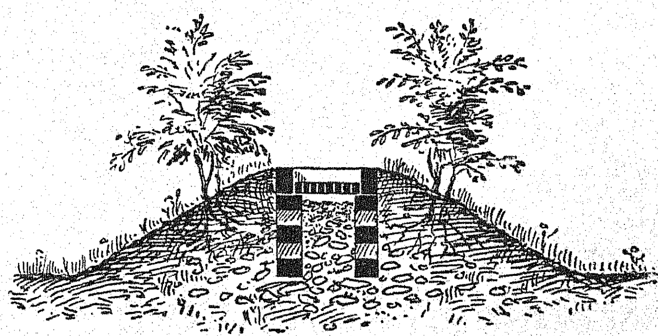


Fig. 431.—Section of Filtration-gutter for Clay Soils.

The ground on both sides of the gutter should be planted with quick-growing shrubs, but there is no reason why vegetables should not be grown if desired.

An example of the working of one of these filtration-gutters will be interesting. After two years' experience, Dr. Poore wrote, "I constructed such a gutter for a girls' school where there are between thirty and forty day-scholars and boarders. I dug out my trench leading into a natural rivulet, and I formed a gutter forty feet long. I do not think the slops in this case

have ever travelled as much as six feet, and there is no evidence that a drop of slop-water has ever touched the rivulet. The privets have grown, but the gutter has never been foul, and when the tiles have been taken up, the porous rubbish beneath has been found perfectly sweet, and there has been no sloppiness at the sides."

Other examples were given by Dr. Poore, but need not be described in detail. It would, however, have been interesting to know the nature of the soil and subsoil in the several cases, and also whether there was the slightest reason to fear the pollution of the subsoil. As the sewage never travelled more than 6 feet along the 40-feet gutter, it might be more advantageous to construct two shorter gutters (say) 20 feet long, parallel to each other, and so arranged that the sewage could be turned into either of them, the other being at rest for aeration or repairs.

It should be pointed out that Dr. Poore did not advocate the passing of **the wastes from the kitchen and pantry sinks** into the drains without preliminary straining and filtering. These operations can be performed by means of a filter containing two compartments, each 1 foot by 1 foot 6 inches and 2 feet 6 inches deep, and filled with fine gravel. The waste-pipes must discharge over this filter, one compartment being at rest while the other is in use.

Dr. Poore's filtration-gutters are, it must be remembered, intended to purify "domestic slop-water" only, and not for **the purification of sewage containing excreta.** Where the system is in operation earth-closets are used, and the excreta are trenched into the ground in the garden. It would not be advisable to pass sewage containing excreta into such filtration-gutters, as this would inevitably lead to the stoppage of the small holes in the tiles, besides proving a nuisance if near the house. A preliminary straining chamber might be constructed of impermeable materials to intercept the solid matters; it would require to be carefully covered, and very small, so as to necessitate frequent cleansing. A more satisfactory method, however, would be to pass the sewage through a septic tank, and to treat the effluent from this in the filtration-gutters.

In many cases **a simple bacterial system of purification** provides a better way of dealing with the sewage of a house than that of conveying it to a cesspool with all the attendant dangers of such a receptacle. One of the latest domestic sewage-disposal plants, and one that is simple in its operation, is shown in fig. 432. The receiver or chamber is made of a convenient size, and of such a capacity that the solids are retained therein and partly "digested" or liquefied, without setting up excessive septic action, which is always liable

to create an offensive smell. The effluent from this receiver passes out through a submerged outlet on to an automatic tipper, which discharges its contents on to a distributing tray formed of angle-irons set at short distances apart so as to form a number of long, open slots, through which the effluent, after being broken up on the ridges of the angle-irons, is distributed in drops evenly over the whole surface of the filter underneath. It is claimed that there are no small holes in such a distributor liable to become choked, and that it is so simple and reliable that all that is required is to occasionally sweep down

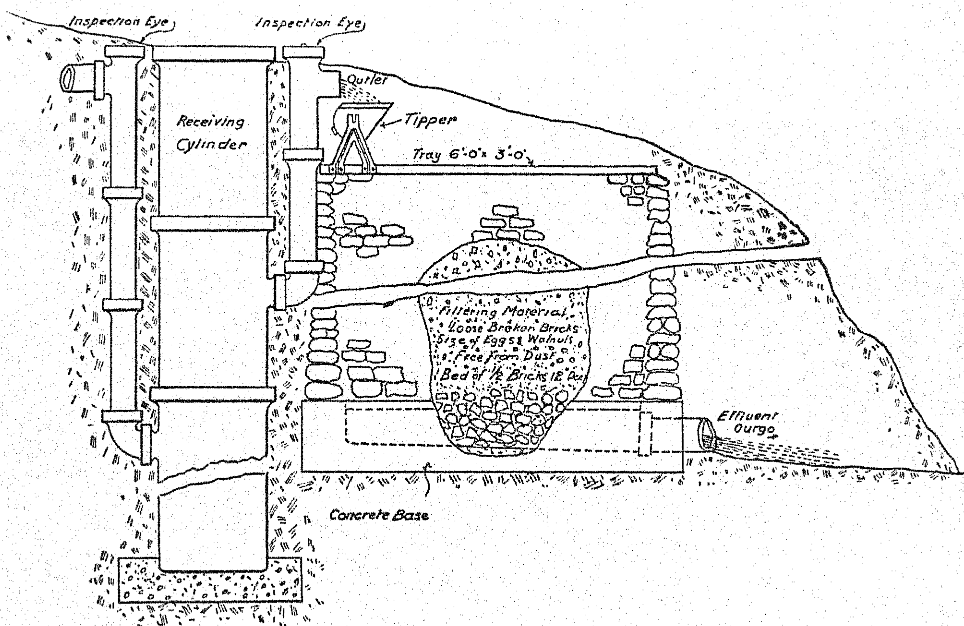


Fig. 432.—The Adams Domestic Sewage Plant.

the tray with a broom. It is also necessary to remove occasionally some of the scum and sludge in the receiver, and to see that the top layer of the filter is clear of leaves or other obstructions. This can, of course, be done by an ordinary labourer or gardener. The filter acts as a "percolating" filter, and should be not less than 4 feet in depth if the fall of the land permits. The area of the filter depends on the quantity of sewage with which it will have to deal. It is stated that a filter 4 feet in depth can produce a perfectly clear effluent at the rate of 250 gallons of sewage per square yard per twenty-four hours.

The bottom of the filter should be formed of concrete or brickwork, and slope slightly towards the centre. The bottom layer of filtering medium should consist of large pieces of stone, brick-bats, or other suitable material laid

about 9 or 12 inches in depth, allowing rather large interstices for efficient drainage and aeration, as it is of the utmost importance that all the moisture should drain out of the filter in order to ensure a proper purification of the sewage. The remainder of the filtering medium should be, preferably, of hard furnace clinker, varying in size from $\frac{3}{4}$-inch to 2-inch gauge, the larger at the bottom, and gradually getting smaller towards the top; nothing less than $\frac{3}{4}$-inch gauge should be used, and all dust and dirt should be carefully excluded by screening and washing. It is contended by the designers and manufacturers of this plant (Messrs. Adamsez, Limited) that a remarkably good effluent

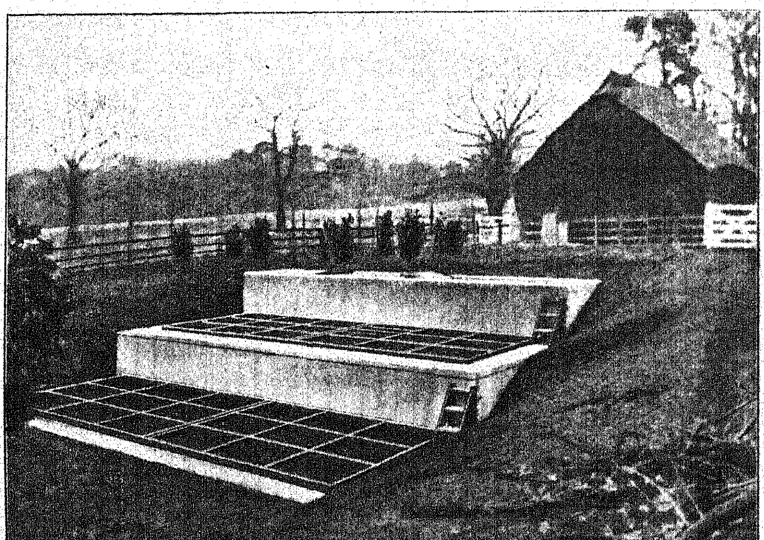
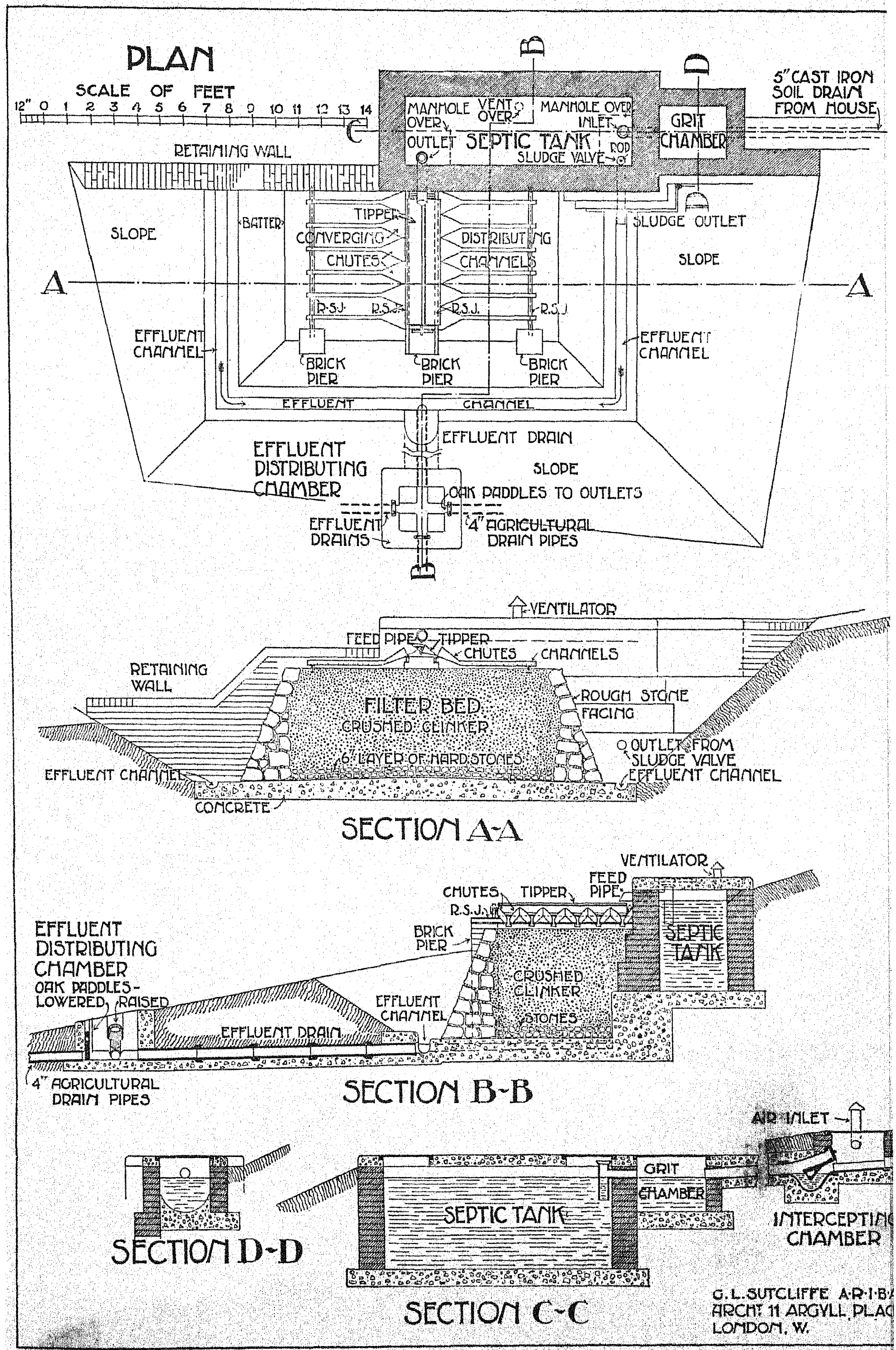


Fig. 433.—Double Contact-beds at The Hermitage, Windsor.

can be obtained by such an installation, and that no nuisance, or the slightest smell, is occasioned thereby; that it is so simple as to be "fool proof", and can be kept in order with a modicum of attention. For an installation of this description, dealing with the sewage from about fifteen persons, the cost of the receiver, automatic tipper, and distributing tray is stated to be £25; the cost of the filter is, of course, dependent on the value of labour and clinker in any particular neighbourhood.

A rather more extensive installation, carried out by the same firm on somewhat similar lines, is shown in fig. 433. This is a photograph of an installation constructed for dealing with the sewage from the Duke of Newcastle's house at The Hermitage, Windsor. It was designed by Messrs. D. Balfour & Son, civil engineers, of Newcastle-on-Tyne, and is capable of dealing with 5000 gallons of sewage per diem at three fillings a day of the contact beds. This maximum



BACTERIAL SYSTEM OF SEWAGE PURIFICATION

quantity has only to be dealt with for a few days in the year during Ascot week, and for the rest of the year the daily flow is only about 500 gallons.

This installation had to be specially designed to meet the fluctuating flow, and is able to do so by the introduction of a "collecting" tank actuated by "Adams" alternating syphons. The collecting tank is equal to the liquid capacity of one of the contact beds. There are two syphons in this collecting

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ance, and in this case Farrer's auto-
matic apparatus was adopted. This consists of a triangular trough, or tipper, divided into two parts by a longitudinal diaphragm, and working in bearings at the ends in such a manner that each part of the trough alternately is brought under the outlet from the septic tank. When one part is full of sewage, the tipper overbalances and discharges its contents into a series of perforated iron channels extending over one-half of the filter. At the same time the other part of the tipper begins to receive the sewage from the tank, and when this is full

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This installation had to be specially designed to meet the fluctuating flow, and is able to do so by the introduction of a "collecting" tank actuated by "Adams" alternating syphons. The collecting tank is equal to the liquid capacity of one of the contact beds. There are two syphons in this collecting tank, which discharge alternately into the two "primary" contact beds. There the effluent is held up by "Adams" timing syphons for the proper period (about two hours), and is then automatically discharged into the fine-grained "secondary" beds. There the effluent is similarly held up, and is then discharged into a ditch. The collecting tank is covered with 2-inch deal planks, and the contact beds are covered with small-mesh galvanized wire-netting to keep off leaves, &c.

It is claimed for this installation that it works automatically, with a modicum of attention, causes no nuisance whatever, and produces an excellent effluent.

An installation for a country house in Surrey is shown in Plate XVI. It was designed by Mr. G. Lister Sutcliffe, the editor of this work, who has furnished the following description:—"The house is normally occupied by about ten persons, and the sewage from a four-stall stable is also treated. The installation consists of a small straining chamber, a covered septic tank holding about one day's flow of sewage and provided with a dipped inlet and outlet, and a percolating filter. The natural fall of the ground was such that the filter was constructed about 6 feet in depth. The bottom of the excavation was covered with concrete, in which channels were formed to collect the effluent. Three sides of the filter were built with large flints excavated on the site, and laid without mortar in order to afford ample aeration for the sewage on passing through the filter. The bottom of the filter was also formed with flints to assist the drainage, and above these crushed and washed coke screened to pass through a $\frac{3}{4}$-inch sieve, and with all fine material screened out by means of a $\frac{1}{4}$-inch sieve, was placed to the required depth. The method of distributing the sewage over the surface of the filter is of the greatest importance, and in this case Farrer's automatic apparatus was adopted. This consists of a triangular trough, or tipper, divided into two parts by a longitudinal diaphragm, and working in bearings at the ends in such a manner that each part of the trough alternately is brought under the outlet from the septic tank. When one part is full of sewage, the tipper overbalances and discharges its contents into a series of perforated iron channels extending over one-half of the filter. At the same time the other part of the tipper begins to receive the sewage from the tank, and when this is full

the tipper overbalances in the opposite direction, and discharges the sewage over the other half of the filter. This arrangement allows the sewage from each half to drain away before the next dose is applied. From the filter the effluent was taken to a small distributing chamber from which three lines of 3-inch agricultural pipes were laid as near the surface of the ground as practicable. Two paddles were provided so that the effluent could be turned into one drain, while the other two were at rest. At the time of writing, the installation has been at

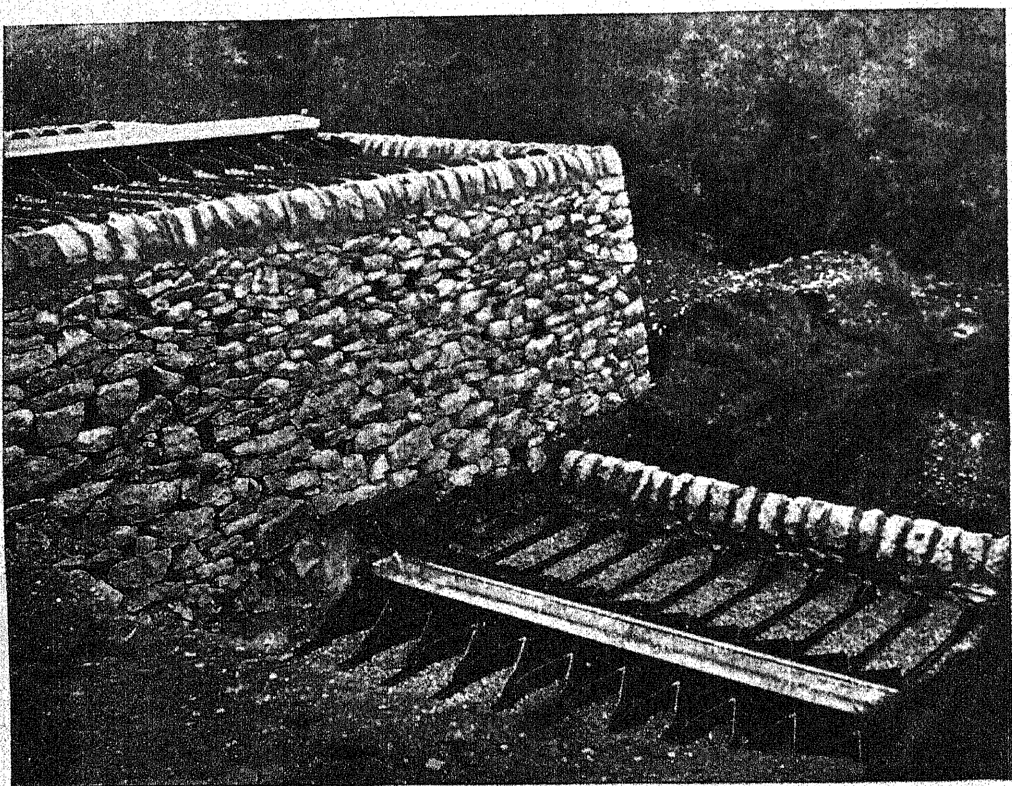

Fig. 434.—Sewage Works, Thornbridge Hall, Derbyshire.

work for more than two years without the slightest nuisance, and during the whole of that period the septic tank has not been cleaned out in any way: the only attention required has been in clearing out the screening chamber, raking over the surface of the filter to remove leaves and weeds, filling the lubricators of the tipper and cleaning it, and altering the position of the paddles in the distributing chamber. A year after the works were constructed, the distributing chamber was replaced by a tank, so that the effluent could be used for watering certain parts of the garden."

The same kind of distributor was adopted by Mr. Sutcliffe in the works

designed by him for treating the sewage at Thornbridge Hall in Derbyshire, but in this case, as the effluent passed into a lake in the park, double filtration was considered necessary. A general view of the two filters is shown in fig. 434. The old septic tank and contact-beds, which had proved an utter failure, were utilized as far as possible, but the septic tank was nearly quadrupled in size as it was originally much too small for the quantity of sewage to be treated. After the new works had been in operation for three months, the effluent was analysed by Messrs. Bostock Hill & Rigby, who reported as follows:—

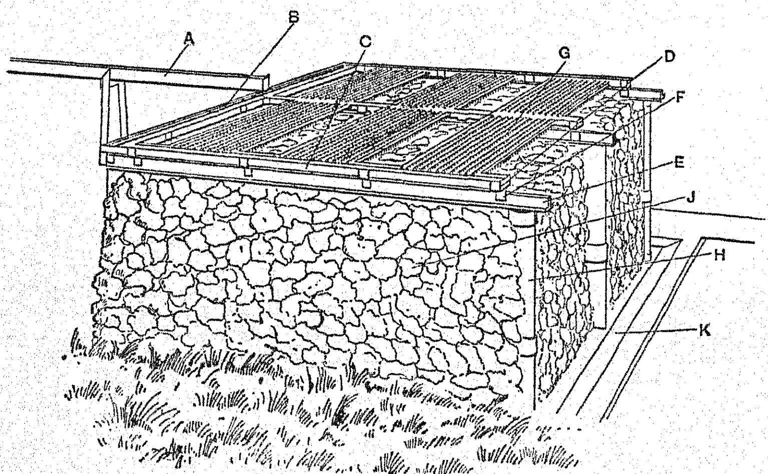

Fig. 435.—The "Stoddart" Sewage-distributor.

TABLE XXIX.

ANALYSTS' REPORT ON EFFLUENT FROM BACTERIAL SYSTEM WITH DOUBLE FILTRATION

BOSTOCK HILL & RIGBY, Public Analysts' Laboratory,
14 Temple Street, Birmingham.

WATER.

Results of Analysis expressed in parts per 100,000.

Description.	Free and Saline Ammonia.	Organic Ammonia.	Chlorine in Chlorides.	Nitrogen in Nitrates and Nitrites.	Total solid matter.
Effluent from Thornbridge Hall, January 28, 1907, from No. 2 filter, ...	0·008	0·032	4·4	0·99	36

February 12, 1907.

REMARKS.

DEAR SIR,—The results detailed above show the effluent to be remarkably well purified, and to be clear and free from odour of sewage. It is also non-putrescent, and may be considered a very good sample, quite fit to be turned into the stream.

Yours faithfully,

(Signed) BOSTOCK HILL & RIGBY.

The method of distributing the sewage over the surface of the filter is of the greatest importance. An equal distribution in small quantities or drops is necessary, and this ought to be effected in a simple manner without complicated mechanism. In addition to the distributors already described, many others have been devised, but two of those only can be mentioned which are specially adapted for private installations. The "Stoddart" apparatus (fig. 435) consists of a series of corrugated and perforated sheets, which are laid over the filter, and

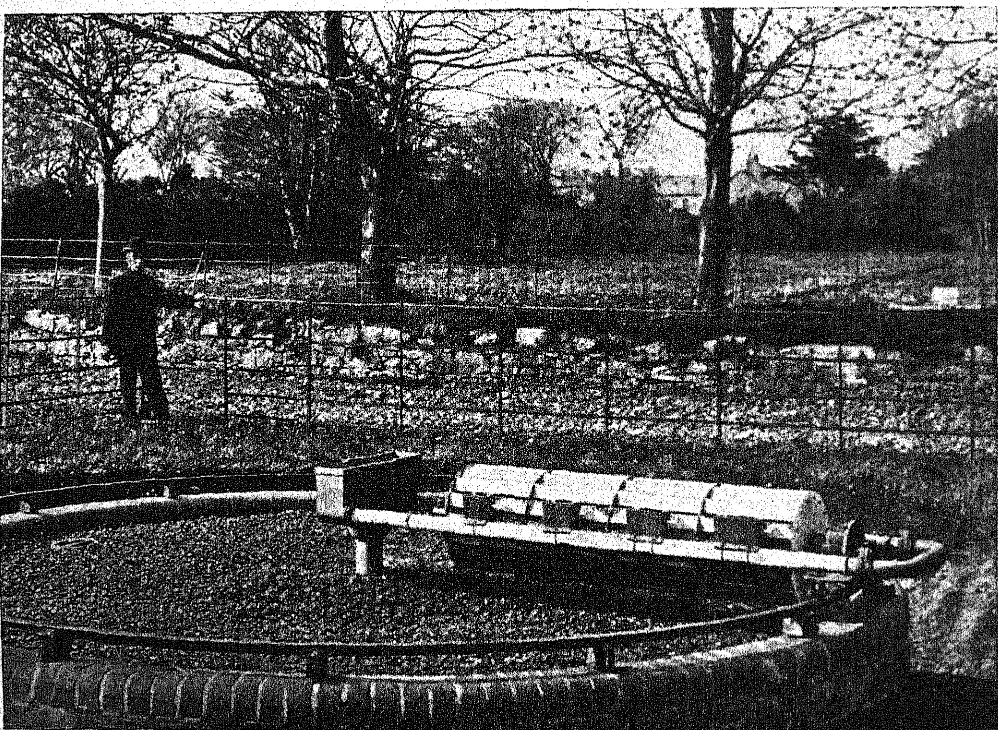

Fig. 436.—The "Fiddian" Sewage-distributor.

allow the sewage to escape in drops through the perforations. The "Fiddian" distributor (fig. 436) is a breast water-wheel operated by about a 15-inch head of sewage. The end of the axle is swivelled on a support in the centre of the circular filter, and the other end is attached to a wheel which moves on a circular track around the filter, as the water-wheel is turned by the sewage.

The design of a system of sewage-purification for a country house or group of buildings is not such a simple matter as the brief descriptions given above might appear to indicate. The position of the tank and filter can as a rule be settled without much difficulty, but in many cases expert knowledge is required to design them in such a way that purification of the sewage will be effected without nuisance. The composition of the sewage may vary within wide limits.

It may be "strong" or "weak" according to the quantity of water with which it is diluted. In some cases the quantity of urine, &c., from stables may be very great in proportion to the domestic part of the sewage. In other cases there may be an excessive amount of grease, and as this is very difficult to treat, its collection in grease-traps may be necessary so that it will not pass to the sewage tank and filter. Even the quality of the water supplied to the buildings affects the purification of the sewage. While, therefore, the quantity of the sewage may be taken as a rough-and-ready guide, the quality must also be taken into consideration, and to ascertain this one or more chemical analyses are often necessary. It may be well to repeat that difficulties will be experienced if surface water and subsoil water are allowed to enter the drains in large quantities; it is best to exclude them altogether. The septic tank itself must be neither too large nor too small, and must be so designed that the contents are not unduly disturbed by the inflow and outflow of sewage. As a general rule, it may be stated that a percolating filter gives better results with domestic sewage than a contact bed, but under certain conditions the latter must be used, and the beds themselves and the apparatus for controlling the filling and emptying must be properly designed to prevent clogging of the apparatus and incomplete discharge of the sewage. In the case of percolating filters, the area and depth of the filters, the nature and size of the bacterial medium, the apparatus for distributing the sewage, and other details, must be carefully considered. The question of single or double filtration must also be answered as the given conditions may direct.

CHAPTER VIII.

INTERCEPTION OR DRY SYSTEMS.

Having thus far treated of methods of dealing with "water-carried" sewage, it will be necessary to turn to the question of what is known as **"interception"**, or the intercepting of the fæcal matter and waste products of our dwellings, &c., without allowing them to enter the sewers. It must not, however, be lost sight of that, in every large community, sewers will still be a necessity, even if an "interception" system is introduced, for, as the Rivers Pollution Commission of 1868 reported (*First Report*, vol. i. 1870, p. 30), "the retention of the solid excrements in middens is not . . . attended with any considerable

diminution in the strength of the sewage, although the volume, even in manufacturing towns, is somewhat reduced". In other words, an interception system will not do away with the necessity for sewers to carry off the slop water, the washings of yards, and also of the public streets, percolations of filth from cesspools, dung-pits, and the like, and also manufacturers' wastes, public urinals, &c.

The crowding of our populations into cities, and the altered conditions of our lives, have made it absolutely necessary that the cleanly and convenient method of carrying away our sewage-matters by water should take the place of the filthy method of storing such matters in or near our habitations. The difficulty of removing and ultimately disposing of this filth is a serious objection against all the so-called **"interception" systems.** These systems may be summarized as follows:—

(1) Various forms of middens.

(2) Box, tub, or pail closets.

(3) Dry-earth, ash, or charcoal closets.

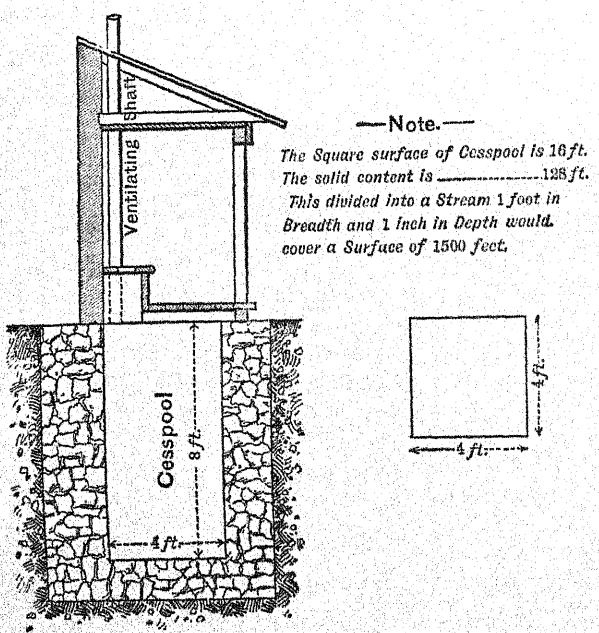

Fig. 437.—Section of Insanitary Privy and Cesspool.

The primitive "fosse", ditch, or simple hole dug into the ground to receive the human fæces gradually evolved into **the privy,** no doubt first by the introduction of some kind of rough seat, and then it was built round and roofed for privacy (hence "privy") and for shelter. Before this advance was made, it is probable that the fosse or hole was lined, or "steined" as it is technically called, with a rough lining of stones or bricks. Then a more modern seat was added, and the privy or midden was complete (fig. 437).

Fortunately the old-fashioned midden-closet is now almost a thing of the past in most of the larger towns in this country, though it is still to be found in rural districts and attached to isolated houses. Mr. Redgrave, in a paper which he read before the Institution of Civil Engineers in 1876,[1] said:

"It can only be spoken of in the language of Mr. Radcliffe (*vide* Rivers

[1] Vide *Minutes of Proceedings of the Institution of Civil Engineers*, vol. xlv. p. 180.

Pollution Commission, 1868, First Report, vol. i. 1870, p. 30) as the standard of all that is utterly wrong, constructed as it is of porous materials, and permitting free soakage of filth into the surrounding soil, capable of containing the entire dejections from a house, or from a block of houses, for months and even years uncovered and open to the rain, the wind, and the sun, difficult of access for cleansing purposes, and unventilated and undrained." And again, in the First Report of the Rivers Pollution Commission, speaking of Manchester, at pages 23 and 24, the commissioners said:—"In spite of district inspection under an energetic and experienced chief, in spite of police assistance, and notwithstanding that the penny post enables every householder so easily to give notice to the scavenger, privies and ashpits are continually to be seen full to overflowing and as filthy as can be. . . . These middens are cleaned out whenever notice is given that they need it, probably once half-yearly on an average, by a staff of night-men with their attendant carts. Occasionally twenty or thirty middens are thus cleaned out in succession, the contents being wheeled along the whole length of the row, making the air offensive for several nights together, and creating a nuisance none the less injurious because, the work being done when the people are asleep, the filthy smell is not perceived." It is almost unnecessary to state that a privy of this description (see fig. 437) is thoroughly insanitary, when it is situated near any dwelling-house.

Later sanitation insists that where **these abominations** exist, the pit shall be lined imperviously—to prevent soakage into the surrounding soil—with hard bricks or stones, set in cement mortar, and rendered or covered with cement mortar or other hard impervious material. Sanitation also insists that the midden shall be so covered and ventilated that the effluvium may pass away harmlessly into the air, and not solely through the seat into the privy building. The pit should also if possible be drained, so as to carry off the moisture, and the shape of the pit should be so arranged that its contents can be easily removed, and with as little nuisance as possible. A still more modern improvement is the provision of some simple arrangement whereby the contents of the pit may be deodorized by the addition of dry earth, ashes, or some such cheap absorbent and deodorant.

It will be seen on reference to fig. 437 how difficult it would be to cleanse such a privy or midden, but the following illustration shows an example of an **improved midden-privy** as constructed at Nottingham. The bottom of the receptacle is concave, in order that everything may gravitate towards the centre of the pit, and the brickwork is well rendered in cement on

the inside to make the pit impervious. There is also a special opening through which ashes or other deodorant may be thrown on to the contents of the pit, and a ventilating shaft is also shown to be carried up, so as to give thorough

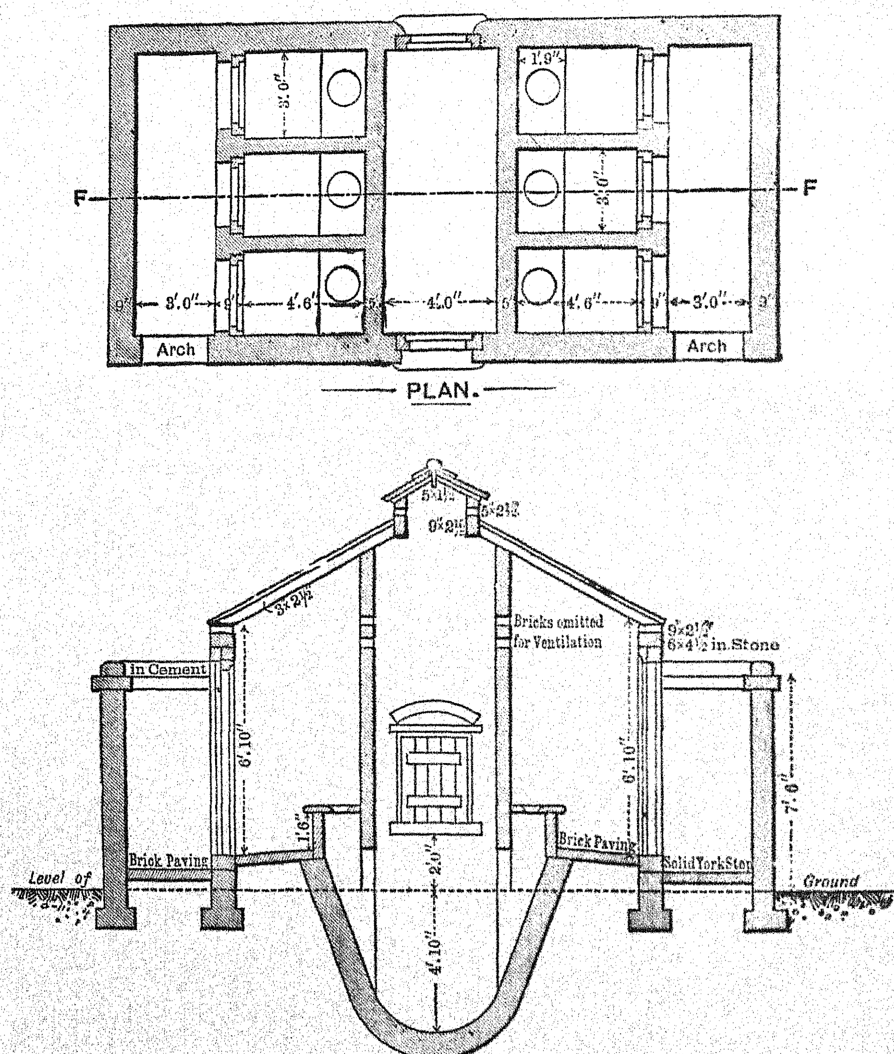

Fig. 438.—Plan and Section of Midden-closet in use at Nottingham.

and safe ventilation. The riser of the seat is constructed in brickwork, and the floor is paved.

The Nottingham type of midden (fig. 438) is free from many of the objections raised against the old-fashioned midden-privy; but a better example is that of **the Burnley midden-closet** (fig. 439), the receptacle of which has the floor constructed of glazed stoneware, with an overflow-pipe connected with

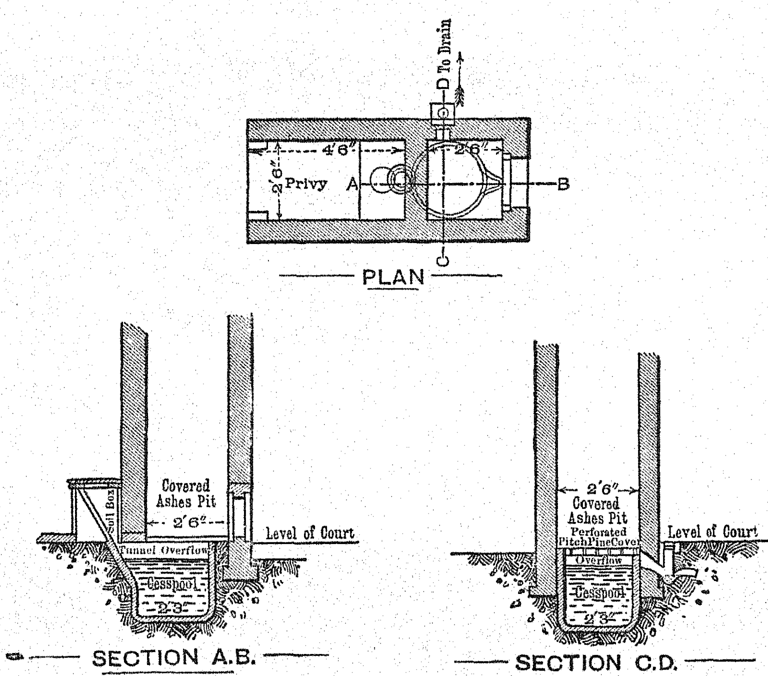

Fig. 439.—Plan and Sections of Midden-closet in use in Burnley

the sewer, and is of such small dimensions that its contents can be easily and readily removed.

A further improvement is shown in **the midden-closet as formerly constructed at Stamford** (fig. 440), where the seat is hinged, so that it can be thrown up

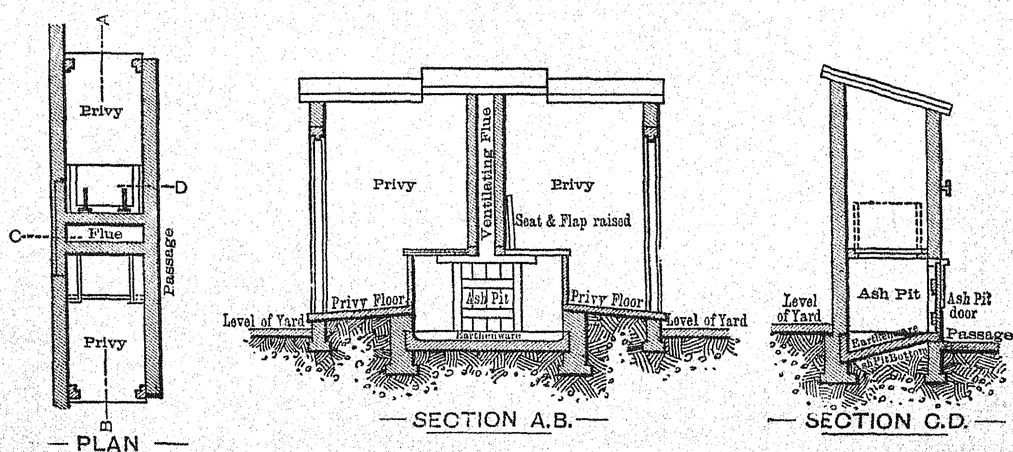

Fig. 440.—Plan and Sections of Midden-closet in use in Stamford.

and the house-ashes emptied on to the contents, as these assist in deodorizing the fæcal and other putrescent matters. The midden is also very shallow, necessitating frequent cleansing.

The final type of midden-privy which will be given, is that which has been suggested by **the Board of Education** in connection with schools where "neither water closets nor earth closets are practicable". It is shown in fig. 441. Two plans are given, the upper showing the door at one end and the lower showing

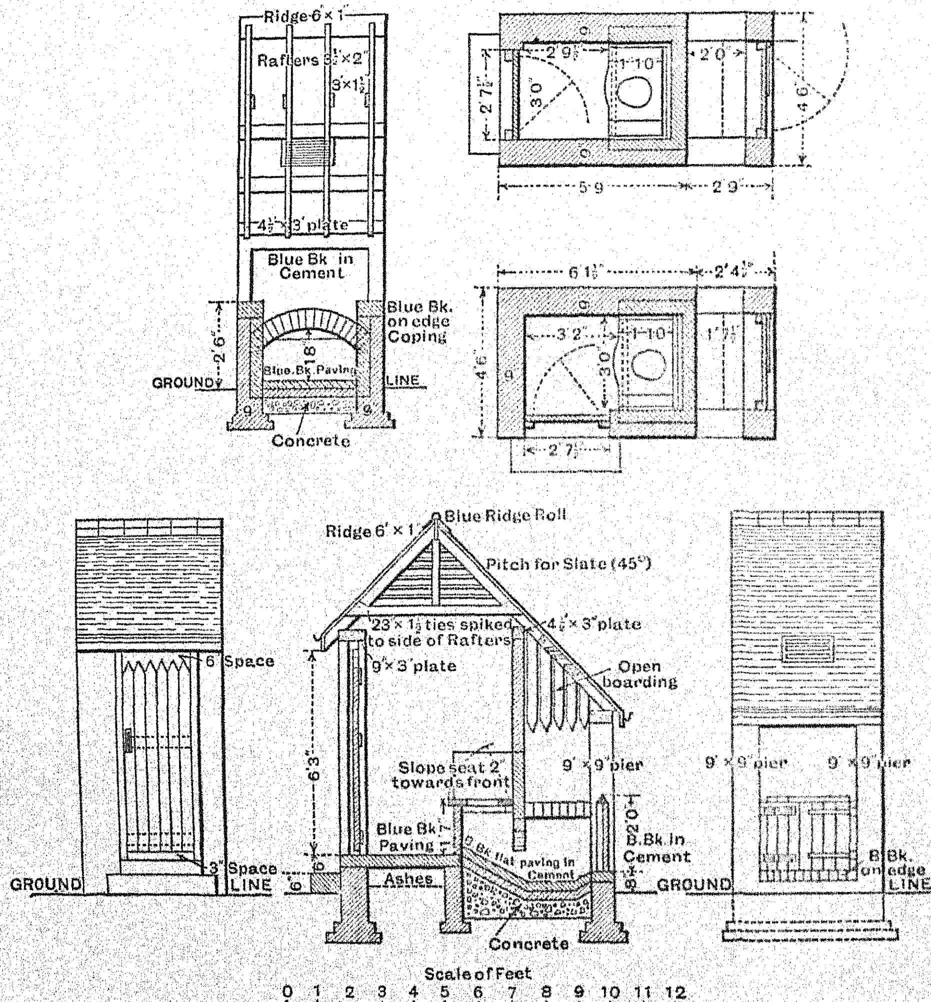

Fig. 441.—Privy recommended by the Board of Education.

it at the side. The front elevation and the longitudinal section show the door at one end, but the other elevation and section apply to either of the two plans. The special features are that the bottom of the receptacle is 3 inches above the ground, blue bricks are used for the walls and pavings likely to be contaminated, and provision is made for the circulation of air through and around the building. It will be seen that the gable ends are fitted with louvre ventilators, and that

open spaces are provided above and below the door. The pit is also thoroughly ventilated, while at the same time rain is almost entirely excluded.

Thus, the midden or privy pit became smaller and smaller, and its transition into **the pail or receptacle closet** was an easy step. This is now known as the "Tub", "Pan", or "Pail" Closet, and is largely used in one form or the other in many manufacturing centres. It is undoubtedly a great improvement on midden-closets, as, on account of the small size of the receptacle, the fæces

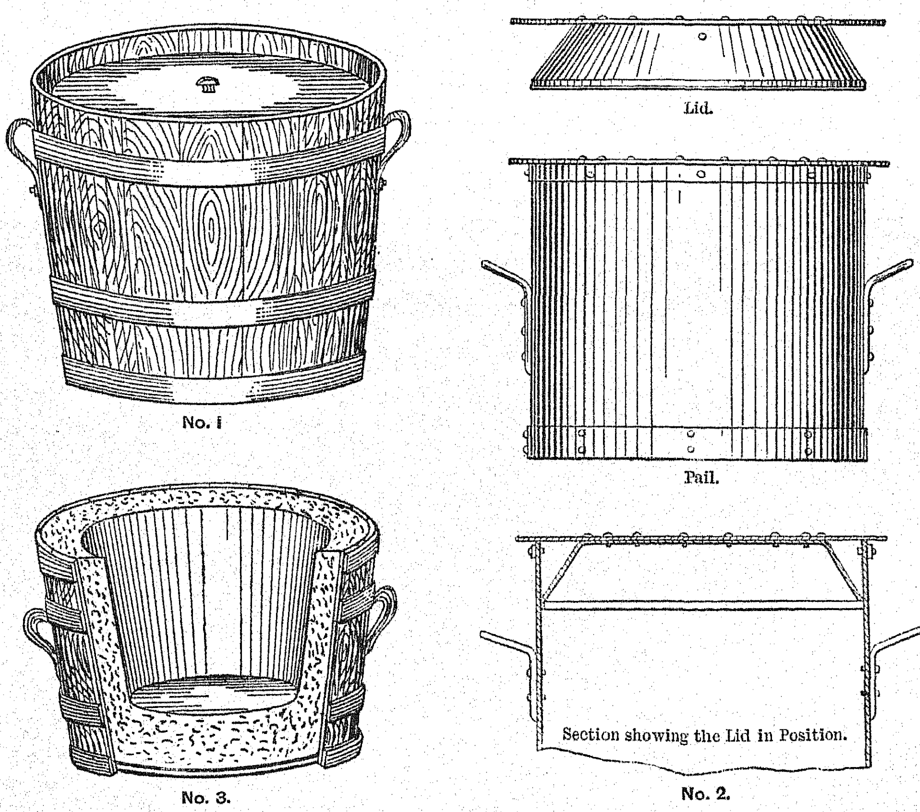

Fig. 442.—Excrement-pails and Covers.

are more frequently removed, and the labour and nuisance of such removal are greatly reduced. Each closet must have its own receptacle, and the front of the seat must be arranged to take out, so that the pail can be easily removed. The pail used at Rochdale is wood (No. 1, fig. 442), while the Birmingham pail and cover (No. 2) are of galvanized iron. The covers are provided to prevent the contents splashing out when the full pails are being carted to the depot.

Manchester was one of the first cities to alter privies into pail-closets, and **to add the ashes to the fæcal matter** as shown in fig. 443. It will be observed that the building in this case is somewhat similar to a common privy, but that

underneath the seat is an iron pail, circular in form, which contains the fæces, &c., and the garbage and other matters which the woman is seen to be emptying into a series of screens or sifters, arranged in a shaft or long box outside the wall of the privy. The finer ashes are sifted out and fall into the pail under the seat, whilst the larger cinders fall down into the box below, from which they can be easily removed by means of a door, and re-burned or used in other ways. There

Fig. 443.—View of Manchester Pail-closet with Cinder-sifter.

are several modifications of this process, by which the fine ash is added to the contents of the pail, all being undoubtedly a great advance upon the old privy or midden.

Not long after the introduction of the pail-system into this country, Mr. Goux of Rochdale introduced **an absorbent pail,** in which the ashes are supplied to the pail before it is sent out, the sides and bottom being lined with ashes pressed into shape by means of a mould, as shown in No. 3, fig. 442. In addition to ashes, the absorbing material contains dry street-sweepings and

factory-waste, to which is added sulphate of lime; the mixture is pressed down, and when the pail is placed in the closet, the mould is withdrawn. It is claimed that the absorbent material takes up the urine and other moisture, prevents decomposition, and facilitates the conversion of the excreta into a portable manure. The opponents of this special pail say that there is nothing in these claims, and that the lining merely adds to the weight of the pail. There can be no doubt, however, that the attempt, whether successful or not, merits approbation.

The collection of the pails is in most cases effected by means of specially-constructed closed wagons, which are sent round, generally at night, accompanied by men, who collect the full pails and substitute empty ones which have been previously cleansed and disinfected at the various depots.

The contents of the pails are variously treated. In some cases they are mixed with a sufficient quantity of dry ashes (house-refuse) to absorb the liquid, and are then placed in a stirring-mill, where offal or other animal refuse is added. Whilst this mixture is passing through the mill, about 5 per cent of gypsum (sulphate of lime) is added to fix the ammonia. The mixture thus prepared consists approximately of about 20 per cent of excreta and urine, 20 per cent of offal, &c., 5 per cent of gypsum or sulphate of lime, and 55 per cent of fine ashes. This is then passed over a fine sieve or screen, which takes out all the coarse parts, and the residuum is put into bags and sold as manure, which is said to be worth about 15 shillings a ton.

The following is a description of **the method at one time followed at Manchester.** The pails having been emptied over a grating which held back the solid matter, the liquid contents were evaporated to one-tenth of the original bulk, or even less, in an apparatus called the "concretor", which consisted of a revolving cylinder, 8 feet long and 4 feet 6 inches in diameter, having its ends partially closed by annular rings, and fitted inside with scroll-like plates of thin metal. The liquid was admitted into this cylinder, and as it revolved, these scroll-like surfaces became wetted; the evaporation was effected by passing heated gases through the cylinder. As these came into contact with the wetted surfaces of the metal scrolls, rapid surface-evaporation took place, the temperature of the liquid, however, remaining low,—so low that, though it was discharged from the cylinder at nearly the consistency of treacle, it was rarely, if ever, at so high a temperature as 130° F.

The hot gases, used for effecting evaporation in the concretor, resulted from the combustion of refuse-material, usually consisting of a small portion of cinders and a large quantity of ashes, together with animal, vegetable, and mineral

refuse, forming a compound containing too little manure to be valuable, but quite enough to be objectionable. This material, so difficult to be disposed of satisfactorily, and often saturated with water, was shot into a furnace of special construction termed the "Destructor", so arranged that the material had to traverse a considerable distance within it, exposed to the products of combustion on their way to the chimney, and to the heat radiated from the roof and sides, before it reached the fire-grate. It was thus effectually dried before any attempt was made to burn it. The products of combustion from this furnace were passed through the "concretor" cylinder to effect the evaporation required there on their way to the chimney. The gases, resulting from the combustion of the materials above described, usually contained a small quantity of sulphurous acid, which was sufficient to slightly acidify the liquid in the concretor. If they did not contain it naturally, a little sulphur was added for the purpose of producing the acid.

The low temperature was not sufficient to cause any appreciable loss of nitrogen, or evolution of ammonia, from the slightly-acidified liquid undergoing concentration. The concentrated material was therefore a fairly strong manure. A random sample of it had been reported upon by Messrs. Burghardt, Grimshaw, & Co., Dalton Laboratory, Manchester, as "undoubtedly a very strong manure, owing especially to the high amount of available nitrogen which decomposes in the ground, and may be expressed as 9·88 per cent of ammonia".

Refuse fuel, such as that used in the "destructor", produced a large amount of clinker, which, when ground up with a little lime, formed a strong mortar. The process of concentration was not a source of nuisance. "Even the most offensive putrid urine speedily lost almost the whole of its disagreeable odour when undergoing concentration, doubtless owing to the action of the sulphurous acid upon it."

The pails themselves had a little charcoal put into them to deodorize their contents, and render them innocuous, and charcoal might in like manner be added to the concentrated liquid to prevent it from becoming offensive. This charcoal was also manufactured from refuse material; it was composed of carbonized street-sweepings, market-refuse, &c., and needed special apparatus to carbonize it, since the low value did not permit of costly handling, while it was bulky and difficult to separate. The heating was effected by a small furnace fed with cinders and other refuse fuel, while the carbonizing kiln consisted of a rectangular chamber of considerable height, into the top of which the material to be operated upon was thrown, and through which it gradually descended as its bulk diminished and the material below was removed.

Finally, when sufficiently carbonized, it was withdrawn through a slide in the bottom of the chamber. The fire in the furnace was kept thick, and the supply of air to it small, so as to prevent the admission of sufficient oxygen for perfect combustion; thus the products of combustion from it could only heat, and not burn, the materials with which they came into contact, and they might therefore safely be brought into direct contact with the materials to be carbonized. These products of combustion entered the kiln, or carbonizing chamber, near the bottom, and were guided around it by iron plates which touched the wall at their top edges, but sloped so that their bottom edges were some distance from it. These ran around the chamber in a spiral form, and kept open a passage, along which the products of combustion could always find a way to the chimney, while, as they were open at the bottom, the gases could come into direct contact with the materials in the kilns. The plates becoming heated also helped to dry and carbonize the materials. Finally, the products of combustion were led away to the chimney through a flue near the top of the chamber.

By the above methods, almost the whole of the material which came into the yard was effectually dealt with, and turned into a product of much less bulk, capable of being applied to some useful purpose either as a manure, a deodorant and disinfectant, or as mortar, while there was no need for costly chemicals or extraneous fuel. At the same time, the whole of the matter was rendered harmless, and incapable of spreading infection or disease, for it was purified by fire.

Another apparatus for the disposal of the contents of pails consists of a **steam-jacketed cylinder** about 13 feet long and 4 feet in diameter, fixed on a hollow revolving shaft, with hollow agitators into which steam is admitted at 60 lbs. pressure. The contents of the pails, mixed with about 1·25 per cent of sulphuric acid, are placed in the cylinder, and the agitators, filled with steam, slowly revolve. About 2½ tons of pail-contents, holding at least 83 per cent of water, are reduced in 3½ hours to about 4 cwts. of a lumpy dark-red loam, containing only about 5 per cent of water. This is allowed to cool, and then riddled into a powder, which is sold as manure, in some cases being of a value of £6 or £7 per ton. Its chemical analysis is given in the following table:—

Insoluble silica, ...	=	3·216	per cent.
Lime, ...	=	1·310	„
Oxide of iron and alumina, ...	=	0·607	„
Sulphuric acid, ...	=	1·885	„
Phosphoric acid, ...	=	3·102	„
Sulphate of potash, ...	=	5·586	„

Chloride of magnesium,	... ...	=	1·910 per cent.
Chloride of sodium,	... ...	=	5·120 ,,
Sulphate of ammonia,	... ...	=	22·191 ,,
Organic matter,	... ...	=	55·073 ,,
	Total, ...	=	100·000

With regard to the dry-earth or pail systems, there can but be one opinion as to their unsuitability for use in towns, and we must agree with the following **conclusions of the committee appointed by the Local Government Board** in 1875 to enquire into the various methods of sewage-disposal:—"That the retention . . . . of refuse and excreta . . . in cesspools . . . or other places in the midst of towns, must be utterly condemned, and that none of the (so-called) dry-earth or pail systems or improved privies can be approved other than as palliatives for cesspit middens".

The committee appointed by the Society of Arts in 1876, to enquire into various subjects connected with the health of towns, came to the following resolutions:—

"(1) That the pail-system, under proper regulations for early and frequent removal, is greatly superior to all privies, cesspools, ashpits, and middens, and possesses manifold advantages in regard to health and cleanliness, whilst its results in economy and facility of utilization often compare favourably with those of water-carried sewage.

"(2) That hitherto no mode of utilizing the excreta has been brought into operation which repays the cost of collection.

"(3) That the almost universal practice of mixing ashes with the pail-products, though it applies there as a convenient absorbent and possibly to some extent as a deodorant, is injurious to the value of the excreta as a manure.

"(4) That for use within the house no system has been found in practice to take the place of the water-closet."

The earth-closet is too well known to demand much description. It was the invention of a clergyman, the Rev. J. M. Moule, and has been in operation for a great number of years. It consists of an ordinary closet-seat, under which is a metal container into which is dropped, either automatically or by means of levers, &c., attached to the seat, or by a scoop, a certain quantity of dry earth, which absorbs the moisture and deodorizes the fæcal matter.

The building in which such a closet is fixed should not be inside the house, but should be a separate building, or approached by a short passage with cross ventilation. It must be well lighted and ventilated, with an impervious floor of asphalt, cement, or tiles. The container beneath the seat should be con-

structed of galvanized iron, and should fit into guides so as to be always directly under the seat. It should be removable either at the back or front, and not contain more than about two and a half cubic feet, so as to ensure constant removal. The contents of the container can be used, with great advantage and perfect safety, in the garden attached to the house, however small.

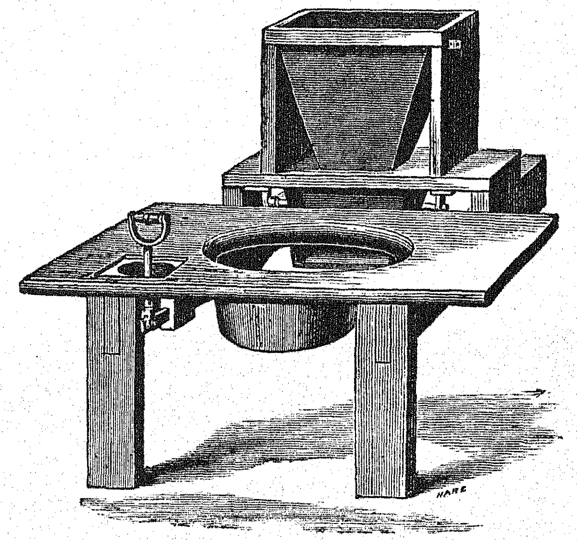

Fig. 444.—View of Moule's Earth-closet, with Pail removed.

Dr. George Vivian Poore, in an excellent book, *Essays on Rural Hygiene*, gives some good advice and practical remarks upon this subject. He says: "In order that the dwelling and its surroundings may be wholesome, it is essential that all excremental and putrescible refuse be removed *every day*. To allow such stuff to accumulate for a week before removal, as is done in some places where what is known as the 'pail system' is in vogue, is quite indefensible, and I believe that a daily removal would be found easier of accomplishment than a weekly removal." He considers that the collected material should be at once buried, and as the material when once put under ground is safe, it might be shallowly buried close to the house and the ground cultivated. "If applied with care and knowledge, it can do nothing but good." No antiseptic must be mixed with it, as of course such admixture would kill

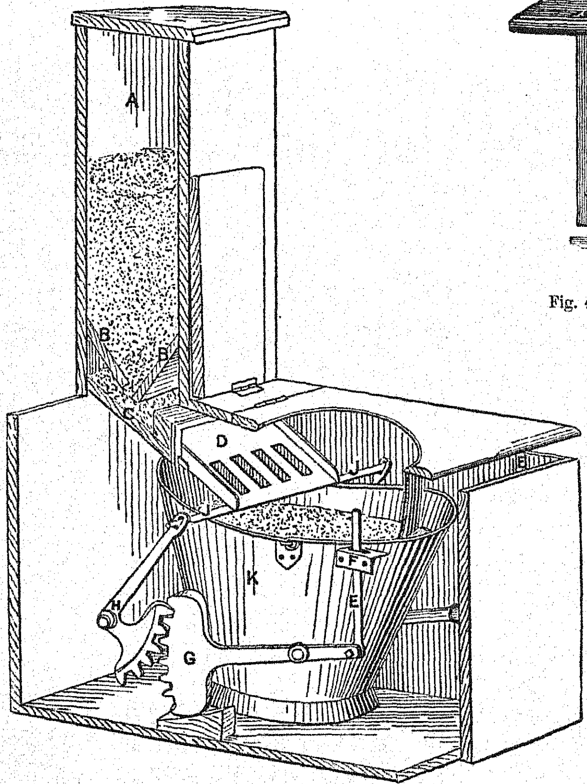

Fig. 445.—Sectional View of the British Sanitary Company's Self-acting Earth-closet.

its fertilizing properties and render the ground sterile, besides killing the microbes which Nature has provided to do the work of purifying.

Earth-closets are now made either to be operated by a handle, as shown in fig. 444, or to be "self-acting", the motive power in the latter case being furnished by the weight of the person using the closet. **A self-acting earth-closet** of this kind is shown in fig. 445. A reference to the illustration will explain the nature and working of this closet. A is a magazine for containing the dry earth, or other deodorizing material used. B and B′ are the sustaining pieces, which bear up the weight of the material, and also form the regulating orifice. C is a bevelled shelf, which is lined with a metallic plate, and carries

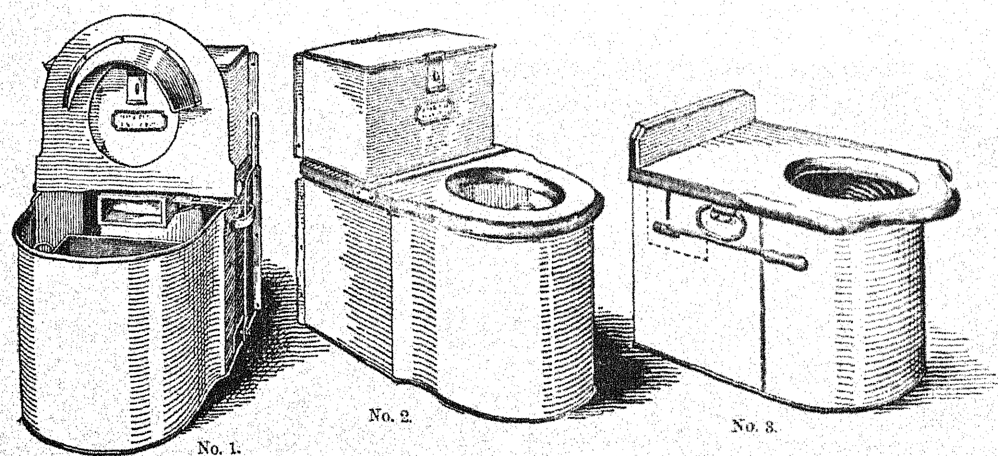

Fig. 446.—Adams's Earth-closets.

in front an iron frame or mouthpiece, through which the perforated shovel or spreader D travels. The action is communicated as follows:—When the closet is being used, the seat is depressed about an inch, forcing down the rods E E on each side of the seat, which raise the long and weighted end of the segmental toothed levers G, which in turn throw back the long end of the lever H. This *duplex action* is coupled by the cross bar J, to which is attached the shovel D. This is then withdrawn to the back of the bevelled shelf C, and receives the charge of earth, &c. When the seat is relieved, the weight of the lever brings out the shovel quickly, thus spreading the earth, &c., over the excreta.

Two other varieties of earth-closet are shown in fig. 446. Nos. 1 and 2 represent the "Domestic" closet, which is made of sheet-steel, either painted or galvanized. The container for the dry earth or other deodorant is at the back of the seat, and is operated by the lever handle shown in No. 1. An

automatic device can be fitted to the closet instead of the lever handle. The pail can be lifted out after raising the seat, or can be removed through an opening in the back wall of the building. The "Miniature" earth-closet (No. 3) has a container of sheet-steel, either painted or galvanized, and the dry-earth box is placed in the upper part of the container under the back of the seat. A handle is provided for discharging the earth. There is no separate pail in this closet, but the container itself forms the receptacle for fæces. The seat can be easily taken off, and the container can then be carried away to be emptied. This is a simple arrangement. As the container and earth-box are small, the apparatus must be emptied at short intervals, and this is an advantage from the sanitary point of view. In some earth-closets, made by the same firm, the container is of glazed stoneware.

Cinder-sifters are made for screening out the coarse parts of domestic ashes. The fine dust thus obtained is well adapted for use in earth-closets.

NOTE ON THE LEGAL INTERPRETATION OF THE WORDS "DRAIN" AND "SEWER".

BY

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NOTE ON THE LEGAL INTERPRETATION OF THE WORDS "DRAIN" AND "SEWER".

According to the Public Health Acts Amendment Act, 1890, Section 19 (1):— "Where two or more houses belonging to different owners are connected with a public sewer by a single private drain, an application may be made under section 41 of the Public Health Act, 1875 (relating to complaints as to nuisances from drains), and the Council may recover any expenses incurred by them in executing any work under the powers conferred on them by that section from the owners of the houses in such shares and proportions as shall be settled by the surveyor, or (in case of dispute) by a court of summary jurisdiction"; and Section 19 (3) provides that "for the purposes of this section, the expression 'drain' includes a drain used for the drainage of more than one building".

Mr. M'Morran's note to this sub-section is as follows:—

"The provisions of sub-section (1) and of this sub-section make the word 'drain' applicable to a drain which receives the drainage of two or more houses belonging to different owners. Such a drain would formerly have been a sewer, and as such vested in and repairable by the local authority, and there was not such a thing as a single private drain of this kind if the word private means not vested in the local authority."

It will be noticed that for the first time we have, in this section, any statutory recognition of public sewer and private drain.

The most noted decision is Travis *v.* Uttley. A drain passing under three houses at Halifax was held to be a public sewer by the Court of Appeal, on 4th December, 1893 (L.R., 1894, and Q.B.D., p. 233). Since that date it has transpired that the Public Health Acts Amendment Act, 1890, had not at that time been adopted in Halifax. At Hove, an owner, relying on this case, did the work, and in the County Court secured a judgment against the Commissioners, who appealed, and succeeded in getting the judgment reversed (see Self *v.* Hove Commissioners, Q.B.D., 685, 25th January, 1895); Justices Wills and Wright decided that the Commissioners were not liable for the cost incurred in recon-

structing a drain which it was discovered drained a house adjoining that in respect of which a notice had been served, and further held that the Commissioners having adopted Part III of the Public Health Acts Amendment Act, 1890, the drain was not a sewer, and therefore not repairable by them, and consequently their notice did not amount to a request to the plaintiff to do the work.

This decision was, a few weeks later in the same court, April 3, by the Carlisle case, Hill *v.* Hair (Q.B.D., 906), considerably limited. The respondent was the owner of one of several houses erected before the passing of the Public Health Act of 1848. The Corporation had adopted Part III of the Public Health Acts Amendment Act, 1890, and their Improvement Act of 1887 contains a section (134) somewhat similar to section 19 of that Act, with the omission of the words "belonging to different owners". The combined drain being defective, the Council proceeded against the respondent by summons, which, however, was dismissed by the magistrates on the ground that the drain was a sewer vested in, and repairable by, the authority, and the High Court upheld this decision. This judgment seems to imply that section 19 of the 1890 Act does not apply to drains which were already public sewers at the passing of the Act of 1890, and this combined drain having already become a sewer vested in the local authority by virtue of the Public Health Act of 1848, could not possibly be a single private drain "within the meaning of the later Act".

In 1897, in the case of Seal *v.* Merthyr Tydfil Urban District Council, the Court of Queen's Bench came to an entirely different decision, and an interpretation was given of the words "private drain" which is more in accord with what was generally understood to be the meaning of the words until the Halifax case was decided. It is important to compare this Merthyr case with the previous ones quoted. The particulars are as follows:—The case of Seal *v.* Merthyr Tydfil Urban District Council, tried in the Queen's Bench Division before Justices Cave and Ridley, was a case stated by the Justices of the Peace for the County of Glamorgan, sitting at Merthyr Tydfil in January of 1897. Upon the complaint of the Merthyr Tydfil Urban District Council, the appellant (Seal) was summoned for that he being the owner of certain premises Nos. 23, 30, 31, 32, 33, 34, 35, 36, 38 Cromwell Street, allowed a nuisance to exist thereon. The proceedings were taken under section 41 of the Public Health Act, 1875, as extended by section 19 of the Public Health Acts Amendment Act, 1890. A large number of houses had been erected by the Tydfil Well Building Club (of which appellant was the secretary and receiver of rents) upon both sides of a new street called Cromwell Street. The houses on the south side were numbered 21 to 40. A

drain was made by the Club running at the back of the houses through the gardens, and this drain joined the sewer of the District Council. A connection from each house with the drain at the back was made by a branch drain from the water closets and slop sink gullies. The drain commenced at the Council's sewer, and was laid at the back of the houses as far as No. 40, and could not be used by other premises. The Council had adopted the Public Health Acts Amendment Act, 1890. Upon the evidence the justices found as facts:—That the appellant was the owner within the meaning of the Public Health Acts; that the drain was a drain used by two or more houses belonging to different owners; that it was a drain for the particular houses Nos. 21 to 40 in Cromwell Street and for no other premises, and that it was not a general drain into which any houses could be drained; and that the drain was a nuisance and injurious to health. The respondents contended that the drain running at the back of these houses was a private drain under the definition in sub-section 3 of section 19 of the Act of 1890, and that this drain was a nuisance and injurious to health, and that therefore under section 41 of the Act of 1875 the appellant must abate the nuisance. The Court, without calling upon the respondents, upheld the decision of the justices and dismissed the appeal. Justice Cave, in delivering judgment, said:—"This is a very clear case. By the Public Health Acts, 1848 and 1875, a sewer was defined to be a drain used for the drainage of one building only, and it was found that within the language of the Act of 1875 a drain draining two or more buildings became a sewer, and consequently as such became vested in the local authority. This was found to create the difficulty that if a person built two or more houses on his own land, and drained by a drain, such drain became a sewer, and the liability to repair the same was thrown on the local authority. This difficulty was got over by holding that it did not apply to a drain draining houses within the same curtilage, but that such drain, until it came out into public property, was a drain only and not a sewer. Then came another difficulty, namely, where houses belonging to different owners were drained into the same drain by which they were connected with a public sewer. To meet this difficulty section 19 of the Act of 1890 was passed, which enacted that 'where two or more houses belonging to different owners are connected with a public sewer by a single private drain', then section 41 of the Act of 1875 may be put in force; and sub-section 3 says that 'for the purposes of this section drain includes a drain used for the drainage of more than one building'. What is a 'private drain' within the meaning of the section? It appears to me to apply to a drain constructed on private premises to which the public have not access. Private is to be taken in that sense, that is, as being a drain which

is private and constructed on private land—on land which is not open to the public. I think so far as Hill *v.* Hair is concerned the law was wrongly applied there, the substantial distinction being that of a private drain kept up by a person for his own profit. . . . I think the justices were quite right in their decision, as they found as a fact that the drain was a drain for those particular houses and for no other premises."

SECTION IX.—WARMING

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SECTION IX.—WARMING.

CHAPTER I.

INTRODUCTORY.

The subject of warming is one of the most important in the design of a dwelling-house, and the problem as to the best method to be employed in any particular instance, is not always easy of solution. Warming is so closely allied with ventilation that it will be impossible to avoid repeated mention of the latter subject, but fuller information thereon will be found in a subsequent section, written by another author.

So long as **the temperature of the external air** is above 60° Fahr., no system of warming will be found necessary in the British Isles, except in the cases of rooms or buildings occupied by invalids, where possibly a rise of a few degrees may be deemed desirable. When, however, the external temperature falls below 60° Fahr., some means of warming is desirable; and of course when the external temperature falls much below that point, it becomes essential to raise the temperature of the interior of the building, if the comfort of the inhabitants is to be obtained. Opinions vary in different countries as to the most desirable temperature for the interior of buildings; for instance, in the United States the internal temperature is often kept as high as 70° or even 75° F. Most Englishmen consider these temperatures too high for comfort, and it is generally agreed that a temperature of 60° F. is advisable in living-rooms, and about 55° F. in corridors. The temperature, however, should be kept constant, as directly fluctuations occur, there is a tendency to the production of draughts. In our climate, it is necessary to provide for raising the temperature of the interior of the building uniformly to 60° Fahr., when the external temperature is 25° Fahr. Even in the severest winter, the thermometer rarely falls below that degree of cold; and when it does, the apparatus, if properly designed, can be overworked to the small extent necessary.

The methods adopted and considered desirable in different countries vary so

greatly, both from the great differences in the range of temperature and from the prejudices of the various peoples, that I have thought it best to consider the question of warming in its restricted application to dwelling-houses in the United Kingdom, and in countries having approximately the same climatic conditions. Again, the dwelling-house may be considered under two different aspects: *firstly*, the ideal house which one would desire to have built and to occupy personally; and *secondly*, the house provided by the speculative builder, and bought, leased, or hired by the tenant. At the first glance, there may seem to be little difference between the two classes of houses so far as warming is concerned, but there is this essential distinction: if a house be specially designed by a capable architect, for a client who requires the building to be provided with a suitable system of warming and ventilation,—for the two points must be considered at the same time,—then the design may be arranged so as to obtain the most efficient system, so far as that particular house and local circumstances are concerned. Whereas in the other case, the system which can be applied is at best a makeshift and an addition, for it can rarely be said that the problem of warming receives very special attention from the speculative builder.

The systems in use may be divided into two groups: *firstly*, those in which the warming is produced from a number of separate and distinct heating-centres, such, for instance, as open fires; and *secondly*, systems in which the whole of the house is, or may be, warmed from a central source, which distributes the warmth over the building. I shall endeavour to point out the special advantages and disadvantages of the two systems, although in many cases it will be found desirable to use both systems jointly in the same building.

The chief requirements of a good system of warming are the following:—

(*a*) The apparatus should produce and keep up an equable warmth all over the building, or, at least, an equable warmth over every part of a given apartment.

(*b*) The apparatus should not vitiate the air in any way; that is to say, it should not give off objectionable fumes, smell, or gases, which can enter the apartment.

(*c*) The apparatus should not lessen the humidity of the air; that is to say, the humidity of the internal air should be such as would be found in external air, at the temperature of 60° F., on a still morning in spring.

(*d*) The apparatus should not require skilled attention, or be likely to explode, or to cause damage to property, even if somewhat carelessly handled.

(*e*) The apparatus should be of such a nature as to tend to promote ventilation, and in doing so should not impair the incoming air for breathing purposes.

In discussing the advantages and disadvantages of the various systems, the value of each will be assessed by the way in which it fulfils the above requirements.

In some kinds of warming-apparatus, provision is made for allowing the external air to enter through the apparatus, so that they provide ample ventilation and also warmth at the same time. In view of this, it may be desirable to glance at the **experimental data** which have been obtained. Some persons are much more sensitive to draughts than others, but the conclusions deduced by Sir Douglas Galton and others, from experiments, may be accepted, namely, that a current of air having a velocity of 3 feet per second causes no inconvenience, while a current with a velocity of 5 feet per second is objectionable, and one with a velocity of 10 feet per second is felt as a strong draught. A good deal of discussion has taken place from time to time as to the number of times per hour that the air in a room should be changed, and opinions have differed greatly. It is usually conceded that from 1500 to 1800 cubic feet of fresh air should be provided per hour per person, in order that the ventilation may be perfect; if the lower figure be taken, and a velocity of 3 feet per second be allowed to the incoming air, it is obvious that the area of the inlet must not be less than about 20 square inches per person. If this orifice be arranged so that the incoming air passes over or through the heating-apparatus, then the surface of the latter must be so calculated as to enable it to warm the volume of air to the required temperature.

CHAPTER II.

OPEN FIRES AND STOVES.

The open fire was the earliest method of warming houses, and many persons still consider it by far the best. In early times, it was usual to form the fire upon a solid hearth in the centre of the room or hut, and the smoke was allowed to fill the space, and to find its way out at a hole provided in the roof, either directly over the fire, or at some distance to one side in order that the rain might not extinguish the fire. The obvious objections to this system led gradually to the universal employment of special smoke-flues, and the inconvenience of the solid hearth led to the invention of the grate which could get rid of the ashes. It is interesting to observe, in modern slow-combustion grates, the employment of the solid hearth.

One or two essential points should be borne in mind in considering the subject of open fires. An open fire does not warm the air of the room by direct radiation to any appreciable extent, but the rays of radiant heat strike the solid objects, such as the walls and furniture, and these heat the air by conduction.

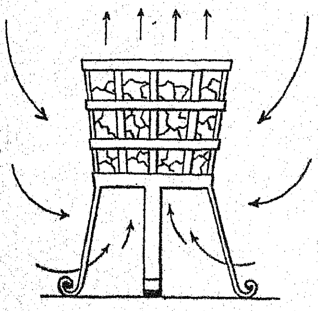


Fig. 447.—Currents of Air produced by an Open Fire out-of-doors.

A fire of course requires oxygen to keep it burning, and the action of combustion in a fire is of the following nature. Air as it is heated expands, and consequently becomes lighter, volume for volume; a fire therefore causes a column of heated air to rise, and its place is taken by colder air which descends. If the fire be burning out-of-doors in still air, the currents induced will be as shown in fig. 447. The rising of the heated column of air can easily be seen over a fire, or over a gas-jet or other source of heat. The air—a mixture of nitrogen and oxygen—is drawn into the lower part of the fire; the nitrogen is merely heated and passes away unchanged, but the oxygen unites with the carbon of the incandescent material, and forms carbonic acid gas (CO_2). This gas rises through the heated mass, and is changed to carbonic oxide (CO); it then combines with another atom of oxygen, and should pass away as carbonic acid (CO_2), if there is perfect combustion. This is the same gas which is produced by human beings and animals in breathing, and should not be allowed to pass into the atmosphere of a room, although this always takes place where coal-gas, oil, or candles are burnt. The presence of the gas is always undesirable, and when present in comparatively large quantities, it is dangerous to life.

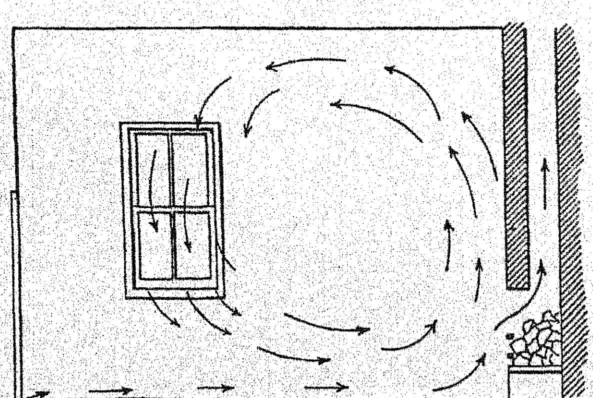


Fig. 448.—Currents of Air produced by an Open Fire in a Room.

The action of an open fire upon the air in a room is represented in fig. 448, from which it will be seen that there is a constant current of heated air rising up the chimney, and to take its place air is drawn from other places, such as the cracks around the doors and windows; if these be carefully stopped up, the fire will not burn brightly but will gradually die out. There is always a current of cold air passing along the floor towards the fireplace. Part of this air passes directly up the chimney, and part is heated by contact with the fire-

place, and rises up the chimney-breast to the ceiling, passes along it, and, as it cools, descends again to the floor level. In a long room, therefore, it is necessary to provide two fires, as the beneficial influence of one will not extend the whole length.

Open fires are unsatisfactory for the purpose of producing uniform warmth throughout the whole air of a room, and also because cold external air from every crack, and the relatively cold air of the corridors, are drawn into the room, producing draughts. The feet of persons in the room are always subjected to a cold current of air, necessitating the use of stools to raise the feet above the floor. In order to diminish or entirely obviate this current, the external air may be brought in by a special duct discharging the air directly under the grate, as shown in figs. 449 and 450. This would supply the fire with air, and would certainly diminish the draught along the floor. It would, however, be a wasteful plan, as the entry of air at such a relatively low temperature, directly under the fire, would necessarily diminish its efficiency and cause a waste of fuel.

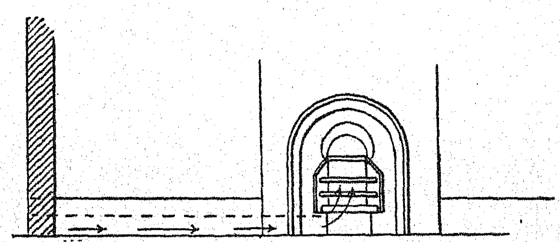


Fig. 449.—Elevation of Fire-grate, with Special Air-duct.

Many attempts have been made to obviate this objection, by passing the incoming air round a portion of the heated structure, before allowing it to come into contact with the incandescent fuel.

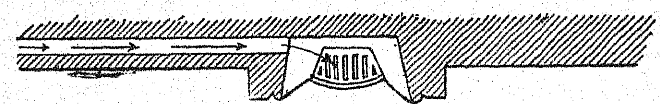


Fig. 450.—Plan of Fire-grate, with Special Air-duct.

The chief advantages of an open fire are its cheerful appearance, and the assistance it gives to ventilation.

A good open fire-grate will conform to certain well-known principles. It must stand well forward. If a fireplace be set back from the room with a flue directly over the incandescent mass of fuel, a very large proportion of the radiant heat must pass directly up the chimney. The aim, therefore, of inventors is to throw the fire well forward into the room, to take away all parts of the structure of the fireplace which prevent direct radiation from the front of the fire, and to promote radiation from the back and sides of the structure.

In order to retain the heat and not allow it to be readily dissipated, the use of iron at the back of the fireplace should be altogether avoided. The next point is to avoid the use of heavy horizontal bars at the front of the grate, and to supersede them by vertical or curved bars, such as are shown in fig. 459, p. 75.

These bars, while effectually preventing the emission of cinders, allow a greater space for the free radiation of heat.

The Nautilus Grate is a kind of slow-combustion dog-grate, lined with fire-brick, and stands well forward into the room, but does not conform to all the principles just stated. A front view of it is given in fig. 451, and a section in fig. 452. One advantage of this grate is that it can be moved out in summer, allowing the space to be filled with plants. The products of combustion rise, and, after revolving within the central tube, pass off by the nozzles, which may be at the back or at the top; the ashes fall into the special ash-pan. It is usual to tile the sides of the fireplace and the hearth. It will be observed that heat is radiated from the whole exterior of the stove, which burns ordinary fuel, and is lighted in the same manner as any ordinary stove. The makers state that a fire 12 inches wide is sufficient to heat a room of 2000 cubic feet capacity, and a fire 14 inches wide one containing 3500 cubic feet.

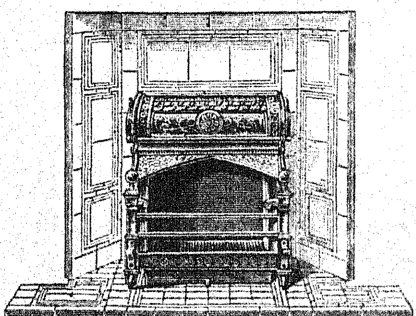


Fig. 451.—Front View of Nautilus Grate.

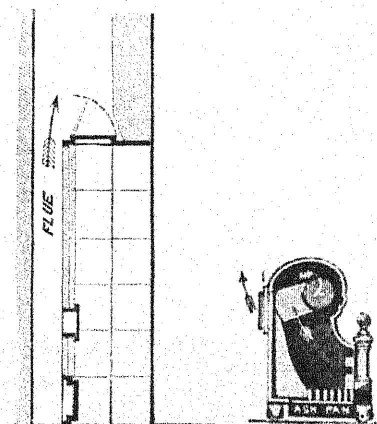


Fig. 452.—Section of Nautilus Grate.

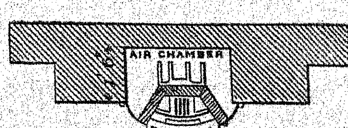


Fig. 453.—Plan of the Galton Grate.

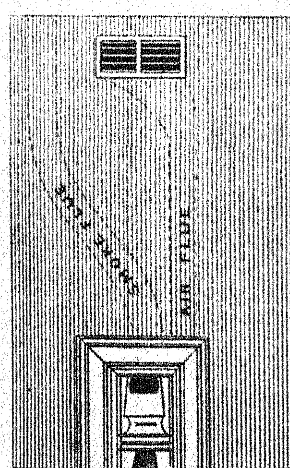


Fig. 454.—Elevation of Chimney-breast, showing Warm-air Flue, &c., from Galton Grate.

A special type of grate for warming incoming air was designed for the War Office by the late Capt. (afterwards Sir Douglas) Galton, and has since become known as **the Galton Stove.** Fig. 453 is a plan of this grate; fig. 454 an eleva-

tion of the chimney-breast, &c., showing the warm-air flue, &c.; fig. 455 a section of the room; and fig. 456 an enlarged section of the grate itself. Fresh air is admitted to a chamber formed at the back of the grate, where it is moderately warmed by a large heating-surface; it is then carried by a flue, adjacent to the chimney flues, to the upper part of the

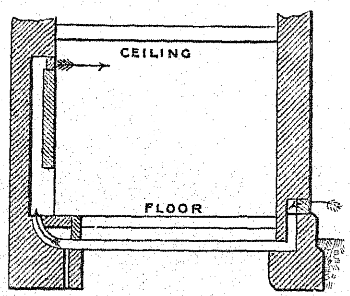


Fig. 455.—Section of Room showing Air-flues in connection with Galton Grate.

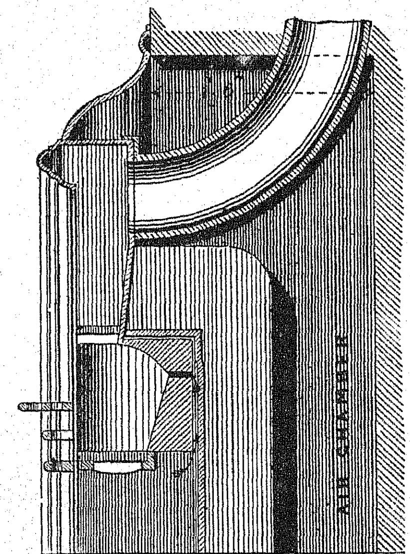


Fig. 456.—Section of Galton Grate.

room, where it flows with the currents which exist in the room. With this form of ventilating grate, the inventor states[1] that the temperature of a room has been found not to vary in any part to a greater extent than 1° or at most 2° F. The body of the stove is of iron, but the fire is placed in a fire-clay cradle; this prevents contact between the lighted fuel and the iron which communicates heat to the incoming air. The radiating surface obtained partly by the back of the grate and its flanges, and partly by the lower part of the smoke-flue, amounts to about 18 square feet.

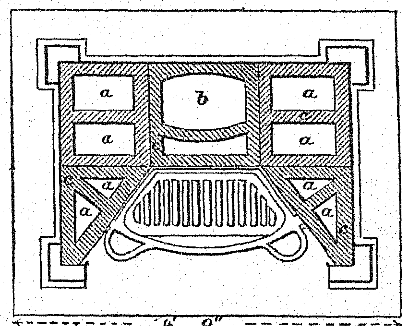


Fig. 457.—Plan of the Galton Independent Stove.

Another form of the Galton Stove, which is in use at the Herbert Hospital, Shooters' Hill, Greenwich, is shown in figs. 457 and 458, the former being a plan, and the latter a section. The chimney *b* passes under the floor, and is placed in the centre of the flue *a*, which brings the fresh air to be warmed by the stove. By utilizing the heat of the flue in this way, more than 36 superficial feet of heating-surface are obtained for warming the fresh air, beyond that afforded by the heating-surface in the air-flues, which is from 12 to 15 feet.

[1] See *Healthy Dwellings*, by Sir Douglas Galton.

The fire stands in an iron cradle, fitted to the fire-clay back and sides, and a current from the air of the room is brought through the fire-clay at the back of the cradle *c*,—where it becomes heated,—on to the top of the fire, to assist the combustion and thus prevent smoke. The top of the stove is coved inside, to lead the smoke easily to the chimney, which passes down into the horizontal flue *b* under the floor. The main body of the stove is a mass of fire-clay, with flues *a* cast in it, up which the fresh air passes from the horizontal air-flue already mentioned, in which the smoke-flue is laid. Thus all the parts of the stove which are employed to warm the fresh air and with which the fire has direct contact, are of fire-clay. The inventor considers that the use of fire-clay is distinctly preferable to the use of iron for such a purpose, as there is less danger of burning the air.[1]

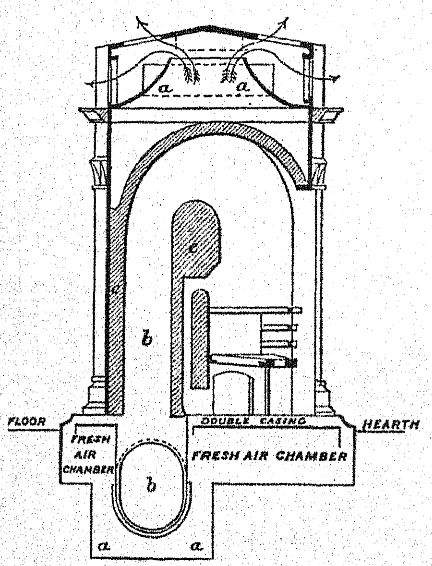
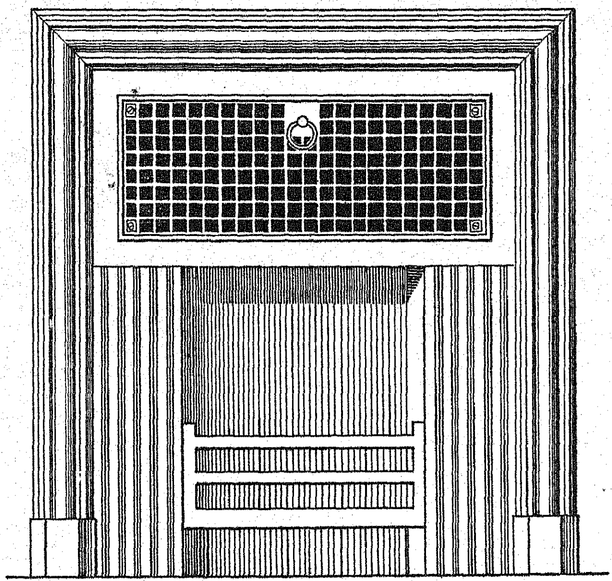


Fig. 458.—Section of the Galton Independent Stove.
a a, fresh-air flues. *b b*, smoke-flue. *c c*, fire-clay.

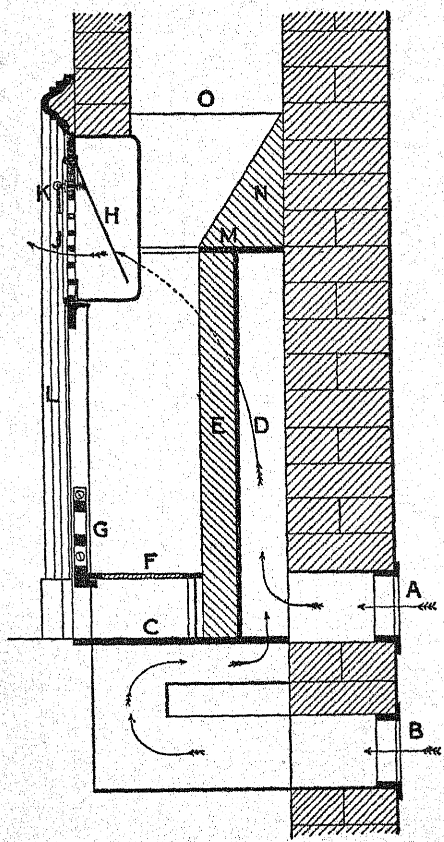
The Grundy Grate is somewhat similar to the Galton grate, and is shown in Plate XVII. The fresh-air opening through the outer wall is shown at A, or, if more convenient, it can be put lower down as at B, or carried as a channel along the skirting-board or below the floor-boards in either direction. The cold air, entering this flue, passes under the cast-iron base-plate C. If the inlet is at B, the air reaches the warm-air chamber D round the back of the fire-grate, and passes into the room through the warm-air duct H, which has a regulating valve K. The grating itself is lettered F, and the bars G, while the whole of the back of the fire consists of fire-brick, marked E. This grate is made in various sizes with various heating capacities.

It is obvious that **the condition of the warm air** entering the room will be, so far as purity is concerned, exactly the same as the external air, and if this is charged with soot, dust, or fog, these matters will be delivered into the room. In the grates described no arrangement is made to purify the incoming air, and while such fireplaces may be suitable for country-houses, they may not be satisfactory for town-houses. Another point is that, in order to obtain economy in the use of the fuel, it is desirable to block up the space between the grate and the hearth, but this point will be specially brought out in dealing with the following type of grate.

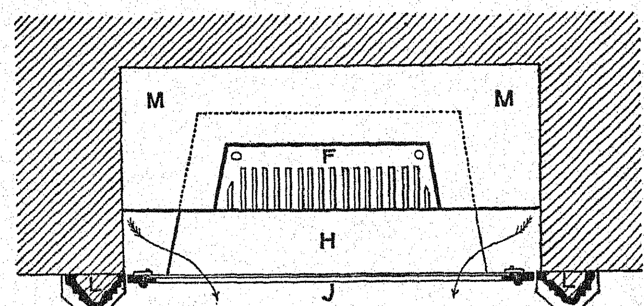
[1] The fire-clay, however, will more easily crack and so admit the smoke into the air-flues.—ED.



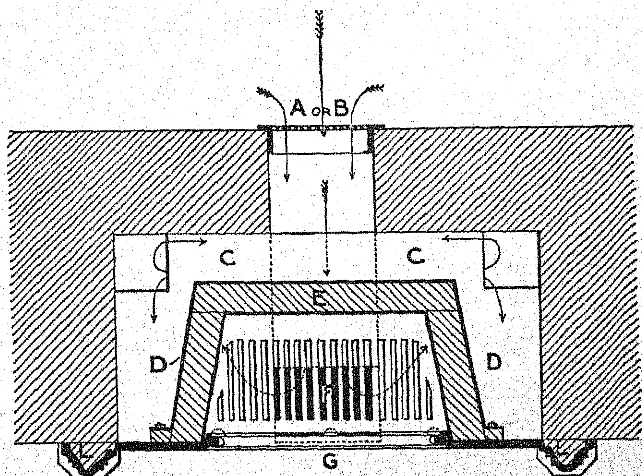
FRONT ELEVATION.



VERTICAL SECTION.



PLAN AT LEVEL OF WARM-AIR OUTLET.



PLAN AT LEVEL OF FIRE-GRATE.

GRUNDY'S WARM-AIR VENTILATING FIRE-GRATE.

A. Fresh Cold-air Inlet Grating.
B. Fresh Cold-air Inlet Grating (alternative position).
C. Cast-iron Base Plate.
D. Warm-air Chamber.
E. Firebrick Back.
F. Bottom Grate.
G. Front Bars.
H. Warm-air Duct.
J. Warm-air Outlet Grating.
K. Regulating Valve.
L. Cast-iron Mantel.
M. Cast-iron Sealing Plate.
N. Brickwork Slope.
O. Smoke Flue.

The Teale Grate owes its design, in the first instance, to Mr. Pridgin Teale, F.R.S., a well-known Leeds surgeon. He was convinced that the waste of fuel by incomplete combustion could be easily lessened, even in an ordinary fireplace, if due precautions were taken by means of simple and inexpensive additions.

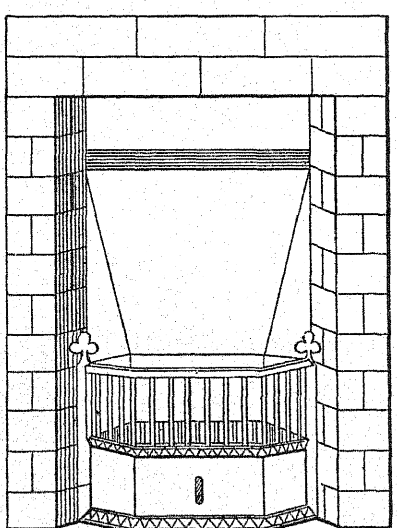


Fig. 459.—Front View of Teale Fire-grate.

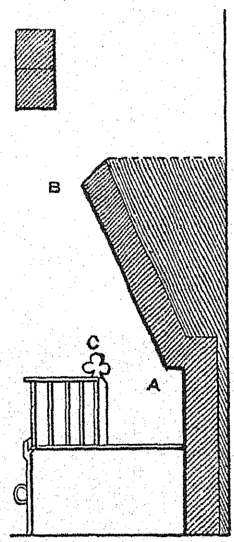


Fig. 460.—Vertical Section of Teale Fire-grate.

Fig. 459 is a front elevation of one of his grates, showing the thin vertical bars, and the economizer, consisting merely of a metal plate fitted in front. Fig. 460 is a sectional elevation, and fig. 461 a sectional plan. The points which Mr. Teale strongly insists upon are these: no air must be allowed to pass in below the grate at all; the space below the grate must be made into a closed hot chamber by means of the economizer; the slits in the grating itself should be made as narrow as possible, and the front bars should be as thin as possible. The whole of the air, therefore, which reaches the fire, arrives at or above the level of the fire, and he considers it desirable to have a solid band, about $1\frac{1}{4}$ inches deep, at the bottom of the bars to hide from view the cinders and dust which are produced. The bottom of the grate should be deep from back to front, probably not less than 9 inches for a small room, or more than 11 inches for a large room. The inventor also lays stress upon the necessity for keeping all

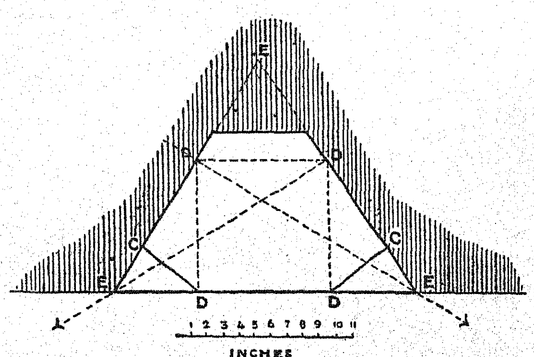


Fig. 461.—Plan of Teale Fire-grate.

iron away from the fireplace. The slope A B (fig. 460) is at an angle of 70° with the horizontal line of the hearth. The plan of the grate (fig. 461) is arrived at by describing a square D within an equilateral triangle E, and cutting off the front angles of the triangle by the lines C D, and the back angle by a line $1\frac{1}{2}$ inches behind the back line of the square.

The Teale grates are now made in a great number of designs; there are, however, **two main types.** No. 1, fig. 462, illustrates the first type, and clearly shows the economizer, the vertical bars, the solid fixed rim forming

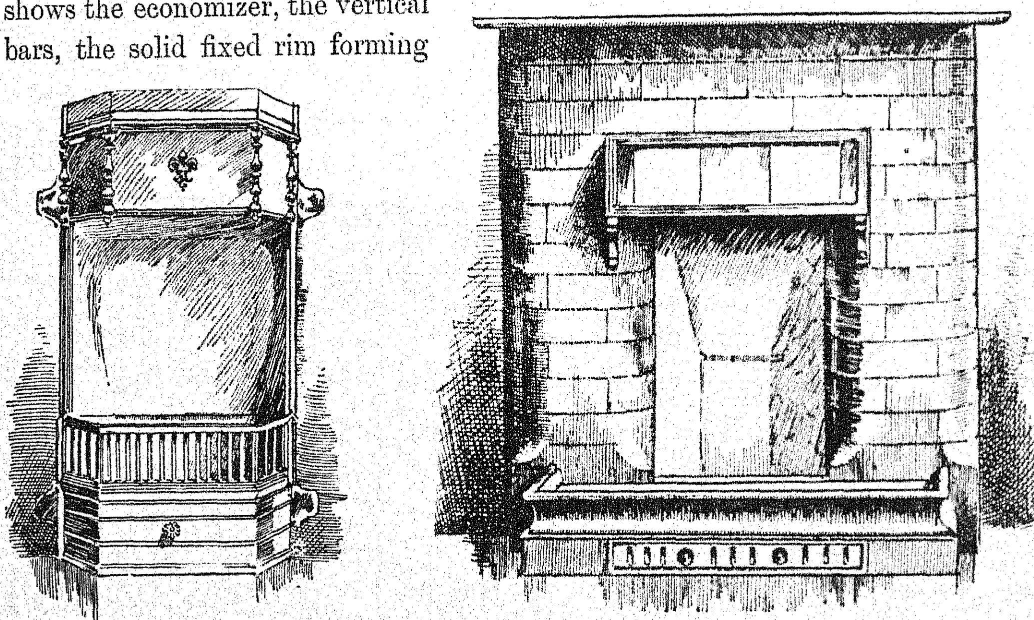


Fig. 462.—No. 1, Front View of the Teale Fireplace; No. 2, Front View of the Teale Front-hob Grate.

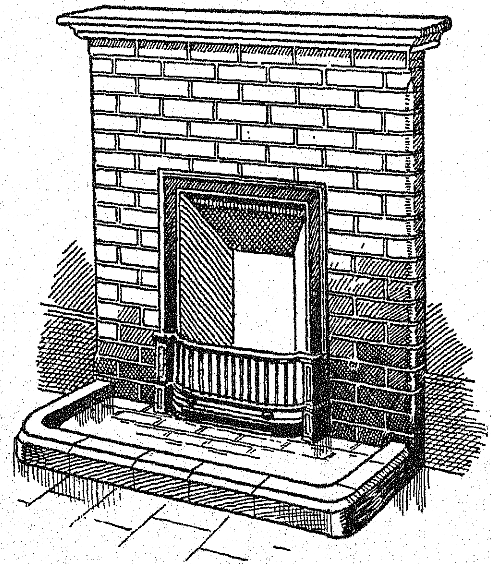
the base of the bars, the fire-brick back leaning forward and standing out at the bottom away from the back of the hearth proper, and the "covings".

The second type, known as **the Front-hob Grate,** is illustrated in No. 2. This has no fire-bars whatever; the fire-clay back and sides are as already described, but the grate is only very slightly above the level of the floor of the room, and a special tiled hearth is built up. This becomes hot, and gives off heat to the room, and thus adds to the efficiency of the grate. Access is afforded to the ash-pit by means of the loose door shown in front, but as this door is provided with several air-inlets, the original Teale principle is departed from to some extent. This type of grate has been found extremely satisfactory.

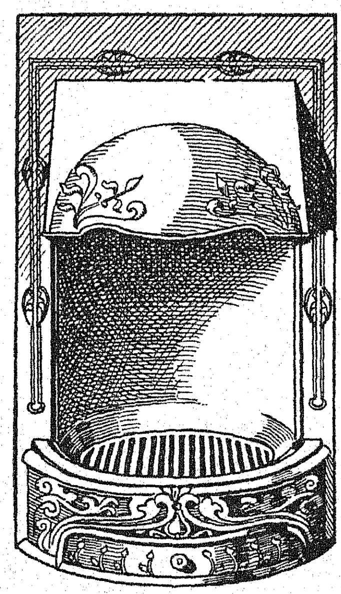
The Rational Grate, not unlike the last, is shown in fig. 71, p. 131, Vol. I.

The Coal Smoke Abatement Society of London carried out a series of smoke-tests of domestic grates in December, 1905, and January, 1906, and the results were published in the latter year. A large number of grates were submitted by

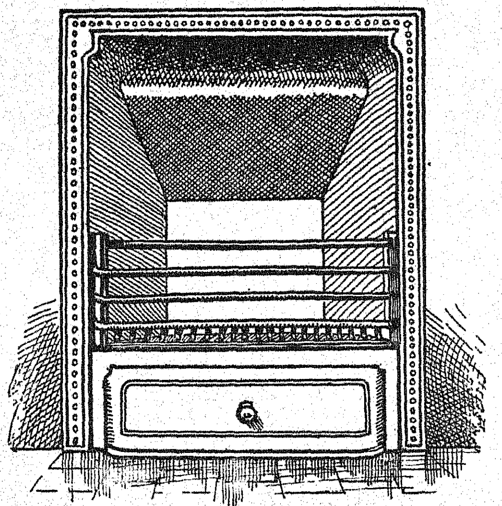
various makers, and 36 were selected and tested under precisely similar conditions in the new government buildings at the corner of Great George



No. 1



No. 2



No. 3

Fig. 463.—Three Modern Fire-grates.
1. The "Devon"; 2. The "Draw-well"; 3. The "Hygiastic".

Street and Parliament Street, Westminster. Each fire was tested for 8 hours upon each of 4 days, and from the 36 grates 5 were selected for further tests. As a final result of the whole of the tests, the examiners found that of the grates submitted the "Draw-well" (Messrs. J. & R. Corker), the "Devon" (Messrs. Candy & Co.), and the "Hygiastic" (Messrs. Hendry & Pattisson, formerly Boyd), all of which are illustrated in fig. 463, are the best, showing practically equal results, and that the "Florence" (the London Warming and Ventilating Company) very nearly approximates to them. It should be remembered that all the grates were worked with the object of obtaining their utmost capacity, and not under conditions obtaining in an ordinary room, which would generally be more variable. The fires were not allowed to burn low, therefore the amount

of smoke emitted in these tests was the minimum that can be expected. The actual results obtained for the best three grates are given below:—

Name of Grate.	Name of Firm.	A	B	C	D	E	F	G	H
The "Devon"	Candy & Co.	25·25	2·6	4·0	43·9	51·7	7·8	84·3	0·85
The "Draw-well"	Corker, J. & R.	26·0	1·3	4·0	43·9	52·75	8·8	70·3	0·70
The "Hygiastic"	Hendry & Pattisson (Boyd)	35·9	2·25	5·75	43·9	55·4	11·5	98·1	0·88

A = Amount of coal less cinders plus half wood, in pounds per day of 8 hours; B = Ashes, in pounds; C = Average stokings per day; D = Temperature in the passage outside the room, in degrees Fahrenheit; E = Temperature in the room; F = Difference between D and E; G = Radiation; H = Smoke.

Boyd's Grates, while having the good points of the original Teale design, also possess several other features of interest. Figs. 464 and 465 show a grate with

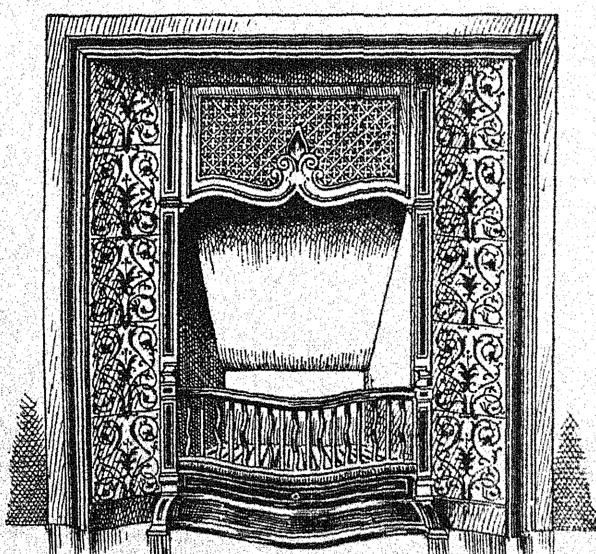


Fig. 464.—Front View of Boyd's Register Grate, with Adjustable Canopy and Regulating Ash-pit.

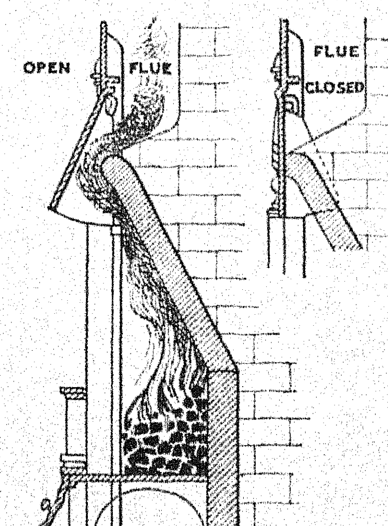


Fig. 465.—Vertical Section of Boyd's Register Grate, with Adjustable Canopy and Regulating Ash-pit.

an ash-pit which may be entirely closed for slow combustion, or opened to any extent desired by simply moving forward the economizer. It has the thin vertical bars and the fire-brick back, but the back slants even more forward than in some of our earlier illustrations, and the canopy register is of a good design, easily regulated to enlarge or diminish the mouth of the flue. The makers of these grates differ from Mr. Teale as to the most desirable angle between the sides and back, preferring an angle of 135°. It is extremely important to keep all the ironwork away from the fire, and this firm has even gone so far as to make the grating itself of fire-clay with slits, as shown in fig. 466. The special

stand for the fire-brick bottom is made of iron, and has an adjustable slide for closing the air-slits. The size of the fireplace can be diminished by the use of suitable blocks, which are specially made to fit the various grates.

The power of a given fireplace may be greatly increased by making it of such a form as to allow the air in the room to circulate round it. This is done in the case of the fireplace shown in fig. 467. In the plan, A is the fuel-basket, B the warming-chamber, and C the brick setting at the back; the V-shaped projections are of iron, and afford a large heating-surface to the air, which passes in at the lower holes and out, in a warmed state, at the upper holes. Such a chamber should be occasionally cleaned out, otherwise it will become choked with dust, and will deteriorate the quality of the air passed through it. The iron just at the back of the fire is protected by fire-brick.

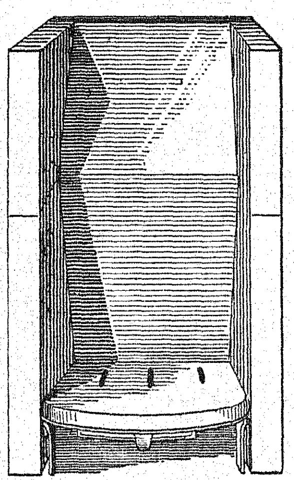


Fig. 466.—Boyd's Grate-body and Grating of Fire-brick.

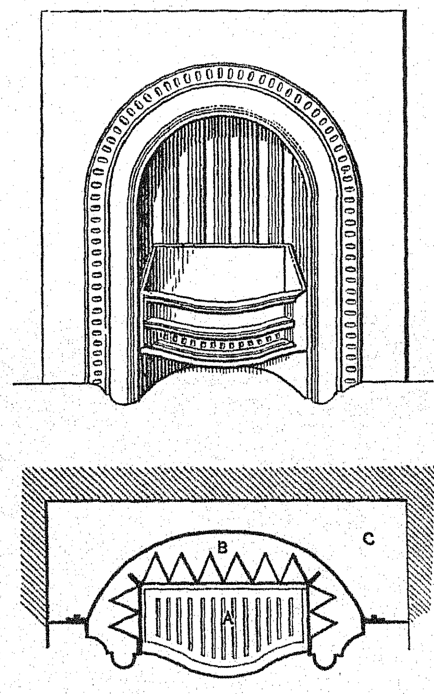


Fig. 467.—Plan and Front View of Boyd's Warm-air Grate.

Heim's "Helios" Smoke-consuming Grates are really stoves, the fire being entirely inclosed. They are specially designed to consume their own smoke. The one objection to them, in the minds of many people, is that the fire itself is inclosed, and the flames can only be seen through a mica door. The design, however, is very ingenious, and well worth describing. The National Smoke Abatement Institution has reported as follows respecting these stoves:—"In the course of twenty minutes the smoke entirely ceased, and the chimney was entirely smokeless during the remainder of the trial. The performances of both

the grate and the stove stand, in point of economy of fuel and efficiency, in the front rank. The fires burned with perfect continuity and regularity, and they were practically automatic in action."

Two views of the Helios fireplace are shown in fig. 468. When the Helios Stove is used with a hopper, it consists of the fire-box A, which is lined with fire-bricks, the hopper B, and the pipe-system C. Under the grate R is

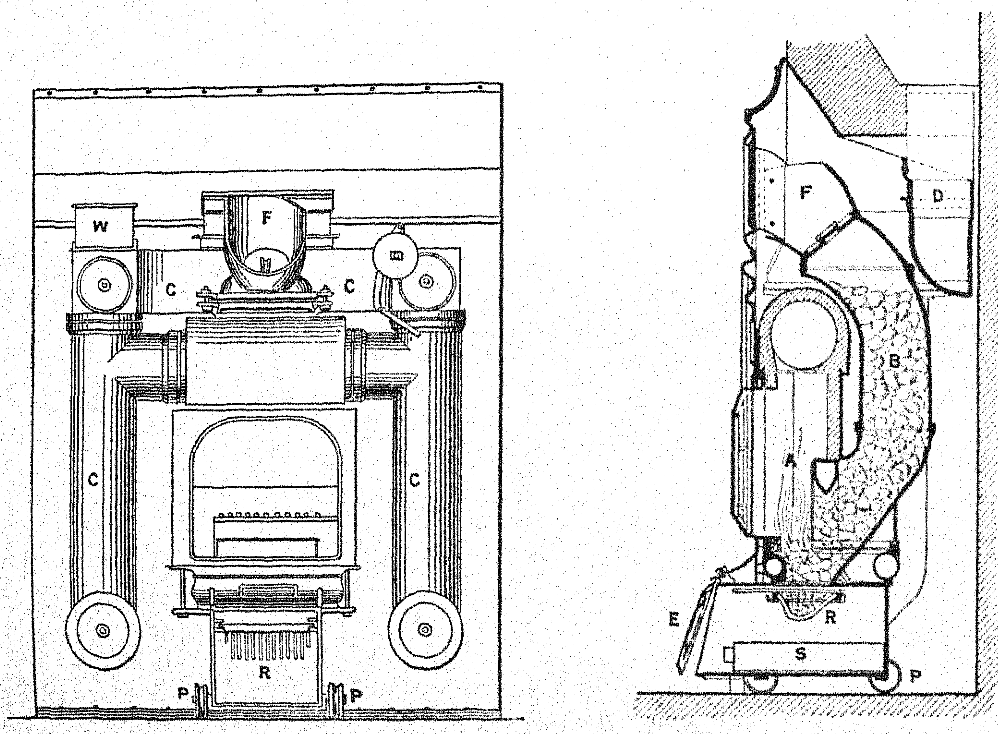


Fig. 468.—The "Helios" Smoke-consuming Stove.

arranged the ash-pan S and the regulating door E. The grate is fed by opening the filling door, and removing the cover in the filling neck F. In the Helios Grate without hopper, the hopper B, the pipe-system C, and the filling neck F are abandoned. The front of the combustion-chamber above the grate is covered by a hinged mica window, which allows the fire to be seen, and possesses the notable advantage of preventing soot, smoke, or burning coals from falling into the room. The whole apparatus is firmly screwed together, and stands on small wheels P, so that it is not a fixture. The heat is diffused partly by radiation and partly by warmed air. The fire heats by radiation through the mica window, and the pipe-system warms the air, which enters cold at the gratings at the bottom of the front, and is returned to the room in a

heated condition through the top perforations at the front. The perforations and mica windows are clearly shown in fig. 469.

By pushing the regulating door as far to the right as possible, the maximum combustion is obtained, while, by moving the door more or less to the left, combustion can be regulated so as to yield the exact degree of heat required. If the regulating door is quite closed, the fire merely smoulders, and, according to the maker's catalogue, burns in that condition about 7 oz. of coal per hour. Economy of fuel is guaranteed by a large area of heating-surface, and perfect control of combustion; and consumption of smoke is attained by injection of pre-heated air on the smoke arising from the fuel. Perfect consumption of smoke is, of course, most important from a hygienic point of view. In grates with hoppers, one charge, it is said, will last from four to twelve hours, according to the heat required. The fire will smoulder all night without attention. To revive it in the morning, it is only necessary to open the regulating door. The replenishing does not affect the burning fuel, so that the fire can be kept alight as long as required. Grates without hoppers hold fuel for 1½ to 4 hours, according to the heat required. Cleaning is necessary once a year. When the heating-chamber is to be cleaned, the grate should first be wheeled out.

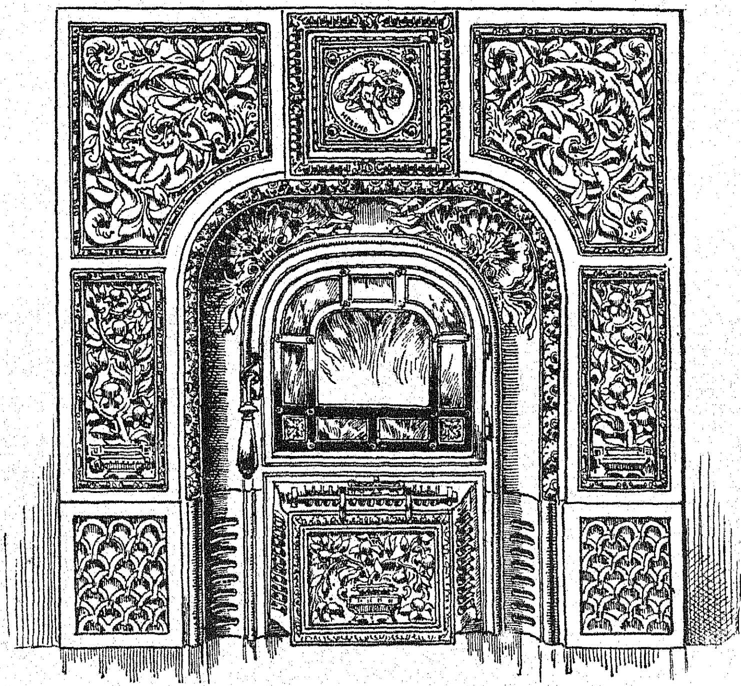


Fig. 469.—Front of the "Helios" Smoke-consuming Stove.

In order to moisten the air, a vessel, which must be daily filled with water, is placed inside the chimney breast. Either the air in the room itself may be passed through the stove, or cold external air may be introduced, warmed, and sent out. Besides this, by an arrangement of suitable flues the warmed air produced in one room may be caused to heat one or two rooms directly over the first. The system then becomes one of heating by warmed air.

These grates, with or without fronts, can be easily inserted into existing mantel-pieces; they are not fixtures. The body of the apparatus surrounding the grate is divided into three parts by fire-bricks; the fire-grate itself forms the middle division. Above this there is an air-channel conducting heated air to the flame, in order to bring about smokeless combustion; above the air-channel there is a register, for the purpose of either allowing a direct draught into the chimney, as in an ordinary grate, or to send the products of combustion through the flues at each side of the grate. These flues can easily be cleaned by removing the cleaning covers, which can also be used as ventilators. In front of the grates there are two sliding mica doors, or one mica door on hinges. The grates are fitted with fronts entirely of cast-iron, or with tile panels, behind which the mica doors slide when opened sideways.

The process of warming can take place in three ways:

(1) If the mica doors and the register at the back are closed, the fire burns with a nice lambent flame according to the position of the lower sliding door, and the grate yields the greatest amount of heat.

(2) If the mica doors are closed, but the register at the back is left open, the grate still burns as described above, but as there is a direct draught into the chimney, only a small quantity of heat is given off into the room.

(3) If the mica doors are open as well as the register, the fire burns as it does in any ordinary grate, and gives hardly any heat into the room, but simply assists the ventilation.

Ventilation can be obtained by opening the valve in the cleaning covers at the bottom of the side flues; the air from the room will at once be drawn into these flues, giving ample ventilation for several persons. The draught for the fire will be slightly reduced thereby.

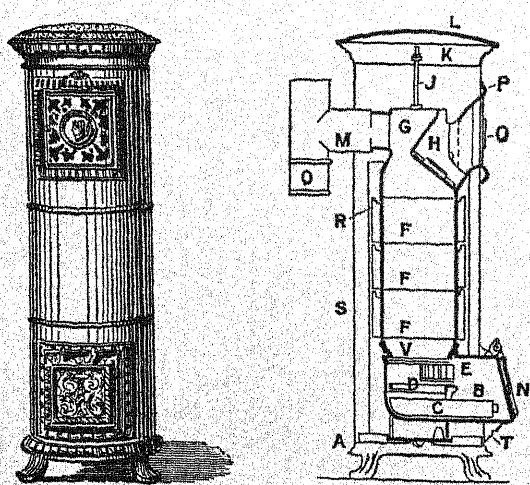


Fig. 470.—View and Section of the "Hestia" Stove.

The "Hestia" Stove, also invented by Mr. Heim, is a true stove, standing away from the wall of the room, and is shown in fig. 470. It stands on a plain or ornamental pedestal A, and consists of the regulating neck B, with regulating door N, movable grate D, fixed grate E, guard-ring V, one or two middle rings F, filling neck G, with smoke-nozzle and smoke-pipe M. The whole is held together and connected with the

pedestal by two iron rods J. This cast-iron heating-cylinder is surrounded by an inner sheet-iron casing R, and an outer one S, resting on the pedestal. The upper part contains the flat filling-door O, with frame P, and the top is surrounded by a cast-iron border K, carrying a perforated cover L. The smoke-pipe M is connected with the flue by ordinary smoke-pipes. In the regulating neck is the ash-pan C. The poker serves the double purpose of raking out the fire and lifting off the filling cover H. In many cases where iron stoves are used for heating purposes the dryness of the air is a source of complaint; in order to prevent this, the "Hestia" stove has a water reservoir suspended between the inner and outer casing, but free from both, so that the water may become very hot but cannot be made to boil. The reservoir is supplied by a tube opening upwards, projecting from the side of the casing, so that it can be easily filled without removing the cover of the casing. All the fuel is lighted from the top, and combustion proceeds downward, so that smoke and gases must pass through the fire, and are thus consumed before reaching the chimney. As the fire is drawn downward it goes out on the top, so that, in stoves with the several middle rings, black coke is visible on the top, sinking gradually down during the combustion. A further proof of the complete utilization of the fuel, is the fact of the smoke-pipe being almost cold.

In order **to burn coal without smoke,** it must be changed into coke. This cannot be done in an open grate, and the arrangement invented by Mr. Heim affords, in my opinion, a very satisfactory solution of the problem, as the thick heavy smoke, which is given off from the coal, is passed through the incandescent mass on its way to the chimney. There is no doubt whatever that the coal can be burnt without producing smoke, except during the first twenty minutes (say) after lighting, and a choice must be made between the cheerful appearance of an open fire, and the efficient consumption of the fuel in a closed stove.

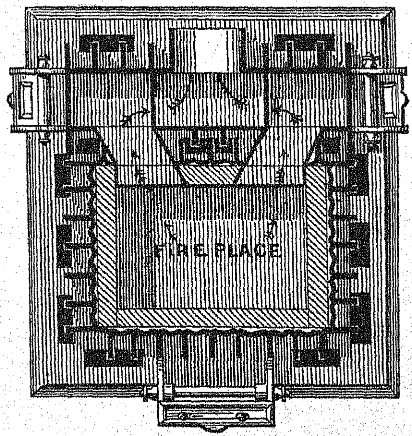


Fig. 471.—Plan of One-chambered Controlled-combustion Heating Apparatus.

The Falkirk Iron Company makes a stove, which is called a **"Controlled-combustion Air-chamber Heating Apparatus".** It consists of an internal stove and an ornamental perforated cast-iron external case, with an air-space between. The plan of the apparatus itself without case is shown in fig. 471, a vertical section in fig. 472, and a front elevation in fig. 473. The bottom and sides of

the fire-grate are of fire-brick. Fuel is inserted at the top, and the smoke-flue descends at the back. The fire-chamber is provided with vertical ribs outside, which project into the air-chamber between the stove itself and the external case. The surrounding air enters at the base of the apparatus, through the holes shown, and passes vertically upwards, and then through the ornamental casing, thus acting as a means of heating by warmed air. If the stove be placed

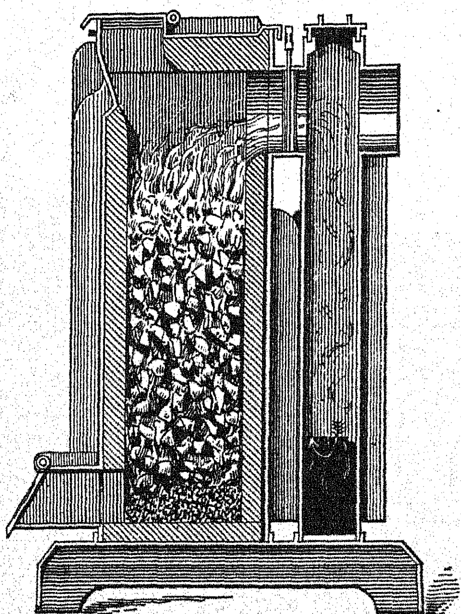


Fig. 472.—Vertical Section of One-chambered Controlled-combustion Heating Apparatus.

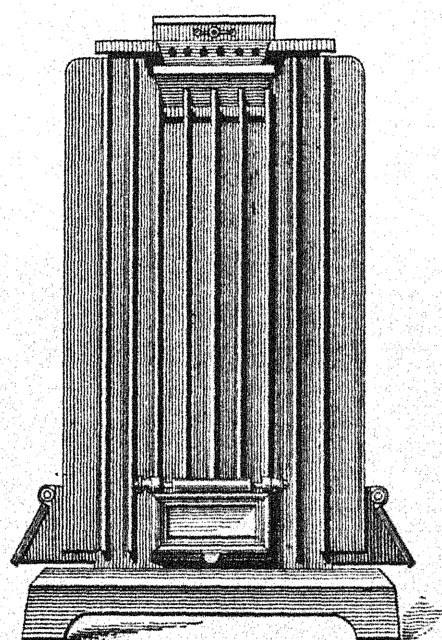


Fig. 473.—Front Elevation of One-chambered Controlled-combustion Heating Apparatus.

over a hole in the floor, connected with an air-duct from the external air, more efficient ventilation will be secured. The makers state that a one-chambered apparatus, as illustrated, with the draught-valve at slow-combustion (or open only $\frac{1}{4}$ to $\frac{3}{8}$ of an inch), will consume 2 lbs. per hour of gas-coke, and heat an apartment containing 40,000 cubic feet of air, at a cost of less than twopence for twelve hours. An evaporating pan placed under the base of the apparatus is found desirable to moisten the atmosphere. The heating-power of the stoves made by this firm vary from 10,000 to 140,000 cubic feet, according to the size of the apparatus. Such a stove is adapted for use in a large hall, and would warm the whole of the staircase and corridors with far less consumption of fuel than would be the case with an open grate.

The Shorland Grate is of the Galton type with a Teale hearth. A section is shown in fig. 474. The back of the grate is of fire-clay, and projects well forward above the fire. Behind it is the warm-air chamber, to which the cold external

air is admitted through a grid in the outside wall. From this chamber, it rises through two special warm-air flues, and is discharged into the room, at a height of about eight feet above the floor, through a hit-and-miss grating. It is of course easy to carry the pipe up through the floor, so as to deliver warm air into a room above. I have already drawn attention to the undesirability of drawing the external air into rooms in town-houses, without previously filtering it in some manner.

The makers say: "In preparing new buildings to receive the Patent Manchester Grates, the best and simplest plan is to build common

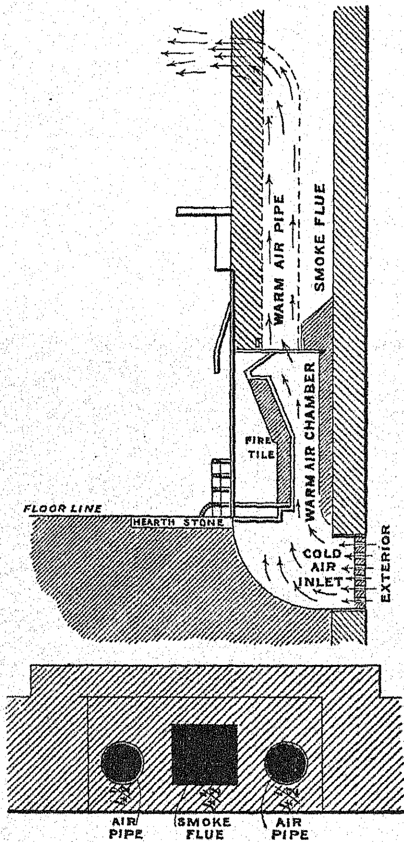


Fig. 474.—Vertical Section of the Shorland Grate and Plan of Flues.

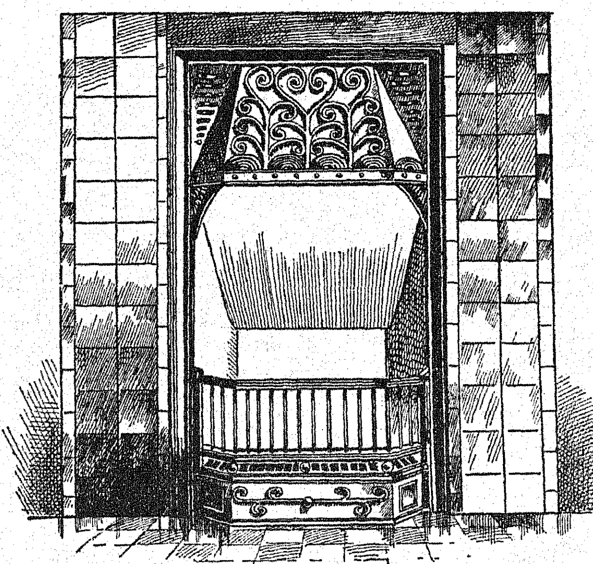


Fig. 475.—Front View of Shorland's Fireplace.

6-inch socketed clay drain-pipes in the solid brickwork of the chimney breast, as the building progresses, for the warm-air flues, keeping them 18 inches apart, $4\frac{1}{2}$ inches from face of brickwork, and commencing 4 feet from floor (socket end upwards). Use square elbows to deliver the warm air into the room through the face of the breast, at about 8 feet from the floor. Then when the building is ready to receive the Manchester grates, they simply require connecting to the clay pipes by means of our own syphon pipes or other connecting pipes. The outside cold-air grids should also be built in as the building progresses." For size No. 1, the opening in the brickwork must be 48 inches high, 30 inches wide, and 14 inches from back to front, and the heating capacity is 3000 cubic feet of space, *e.g.* a room 20 feet long, 15 feet wide, and 10 feet high. Fig. 475 repre-

sents one of these fireplaces. It differs from Teale's in the form of the bars, as the space exactly above the grating is left open instead of having a solid piece to hide the ashes.

An arrangement, which, in my opinion, is of superior merit, is shown in fig 476. This is **Shorland's Calorigen.** It consists merely of an iron box con-

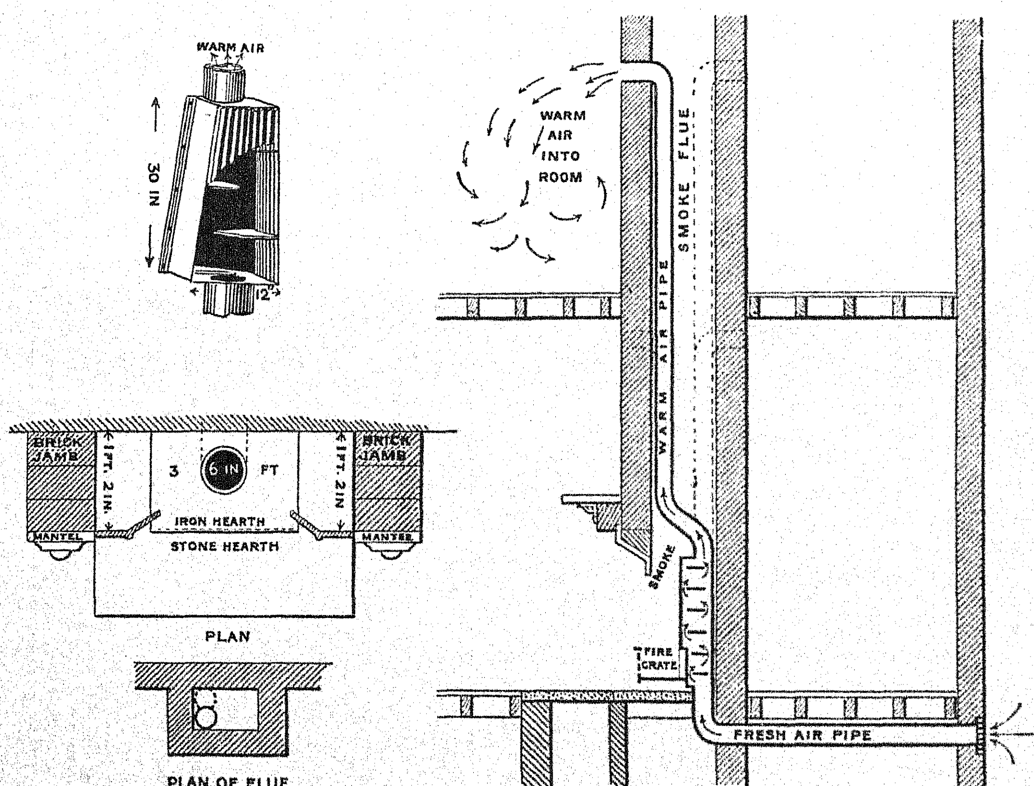


Fig. 476.—Shorland's Calorigen.

taining a series of baffle plates, which is fixed directly at the back of the fire, in a room on the floor below that of the room to be warmed. As the warm-air pipe is of metal, it readily receives heat from the smoke. I would suggest that, wherever it can be done, a case of some kind should be provided in front of the outside grid, in which muslin could be stretched to filter the air to some extent before it enters the room.[1]

The smoke-nuisance is undoubtedly due in a great measure to the imperfect combustion of fuel in household fires. Indeed, some authorities go so far as to say that houses are greater sinners in this respect than factories and workshops. Attention has already been drawn to certain grates in which the smoke is almost

[1] For some critical remarks on ventilating grates and stoves, see Chapter VIII., Section XI., Vol. II.—Ed.

entirely consumed, and something will now be said concerning a process designed to prevent the emission of smoke. It may be assumed that, where open fires are used, it is quite impossible to prevent the production of smoke; the only question, then, is as to whether the emission of the smoke produced can be prevented. Colonel Dulier has succeeded in doing this to a very considerable extent. His apparatus has been in use for some time at the saw-mills belonging to the city of Glasgow, as well as in private houses. The apparatus is very simple. A jet of steam is inserted into the base of the smoke-flue, and the action of the steam upon the smoke facilitates the subsequent treatment, which consists of spraying water upon the smoke. The spray of water is emitted through very small holes in pipes placed inside the smoke-flue, and it has been proved by analyses, made by the City Analyst of Glasgow and by others, that about 94 per cent of the soot, and about half of the sulphurous acid, are in this way washed out of the smoke. This is, of course, a very satisfactory result, especially as the cost entailed in working the apparatus is little more than that of the water required for the purpose, and the action is practically automatic. A considerable part of the residue, obtained by drying the waste brought down by the water, is found to be unconsumed carbon, and this could of course be burnt, if it were found to be worth the trouble.

CHAPTER III.

GAS-STOVES AND OIL-STOVES.

1. *GAS-STOVES.*

That the gas-stove is now so largely and so successfully used, is probably due more to Mr. Fletcher of Warrington than to anyone else. He made the subject of heating by gas a special study, and perfected the use of the atmospheric burner for this particular purpose. It seems a very simple matter to remove the coal from an ordinary fire-grate, attach a small casting provided with a number of holes and an atmospheric burner, and **fill the grate with asbestos balls.** This, however, is probably the most extravagant method of using gas for heating purposes. The grate is not designed for the purpose, and is much too deep to give the best results; it will probably require the addition of firebrick inside at the back to diminish its area, and the register must be closed to a very considerable extent, or the chief part of the heat will be lost. If one of

the ordinary fittings is used, such as that shown in fig. 477, it will probably be found that, if the atmospheric burner be turned down, the gas will produce an unpleasant humming noise; this can only be obviated by either turning the gas partially off at the meter, and so throttling and reducing the pressure, or by using a special valve near the meter, such as Stott's Gas-regulator, set for the pressure most suitable for the stove. No atmospheric burner can be made absolutely silent, but if the stove is desired for use in the chamber of an invalid, special attention should be paid to the choice of the most silent burner possible.

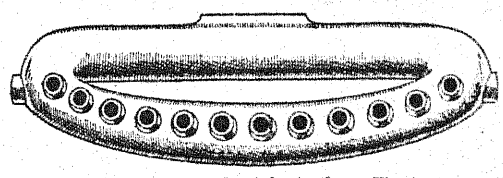


Fig. 477.—Burner for Asbestos-lump Fire in Ordinary Fire-grate.

Too much stress cannot be laid on **the necessity for a flue.** Wherever a gas-stove is used, the products of combustion must not be allowed to enter the room. A mere hole through the wall, with the flue of the stove put through it, is worse than useless, as the draught in such a case is always inwards.

For economy in the consumption of gas a special gas-stove must be used, and of these stoves there are a great number of patterns. If the greatest possible radiant heat be desired, with the appearance of an open fire, the iron fret front should be chosen; the flames of the burners play upon the thin iron, and speedily heat it to redness. The incandescent-ball fire comes next in radiating power. If, however, it be desired to turn the gas low, then a fibrous asbestos front should be used, as with this type the gas-supply may be lessened to a greater extent than with any other.

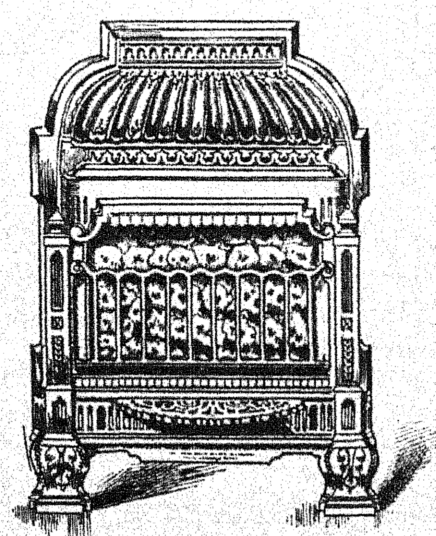


Fig. 478.—View of Gas-stove with Iron Fret Front.

Fig. 478 represents a stove suitable for placing in front of an ordinary register stove; it has **an iron fret front** 16 inches wide, and would be suitable for a bedroom about 20 feet square. The same kind of grate can be used with the ball-fuel, or with the fibrous asbestos.

In order to get the greatest value from the heat generated by the gas, it is desirable to pass the products of combustion around the inside of the grate before allowing them to escape to the flue. Such an arrangement is shown in fig. 479, which represents a gas-stove made by Messrs. Fletcher, Russell, & Co., Ltd. It will be seen that the waste gases pass up and down inside special

passages in the exterior casing before reaching the flue; the casing of the stove therefore gives off a great deal of heat. Such a stove requires a good flue, and a $\frac{3}{8}$-inch gas-pipe. It measures $31\frac{1}{2}$ inches high, $24\frac{1}{2}$ inches wide, and $7\frac{1}{2}$ inches from back to front, and is calculated to warm rooms up to 20 feet square.

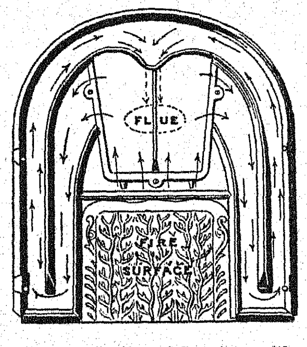


Fig. 479.—Section of Gas-stove with Flues for Utilizing the Waste Heat.

Another form of stove by the same makers, of which a view and vertical section are given in fig. 480, is known as **Fletcher's Tubular Stove,** and gives both light and heat. The cold-air inlet may, if desired, be connected to a pipe carried through the external wall, or the stove may simply be placed in the room; in the latter case a circulation of the air in the room will be set up, the colder air passing in at the bottom, rising through the tubes, and coming out through the grating at the top. The flue must be connected to the chimney-flue, and it may be well to point out that in every case the inlet to the chimney-flue must be stopped by a plate, except where the stove-pipe passes through, otherwise the proper draught will not be obtained. My experience is that, with stoves of this type, it is essential to place a vessel of water on or near them, in order to moisten the air, otherwise it becomes unpleasantly dry. This type of stove is also made with the openings for the air in the front, the tubes being placed horizontally over the burners from front to back of the stove; the fresh air can be drawn from outside if desired.

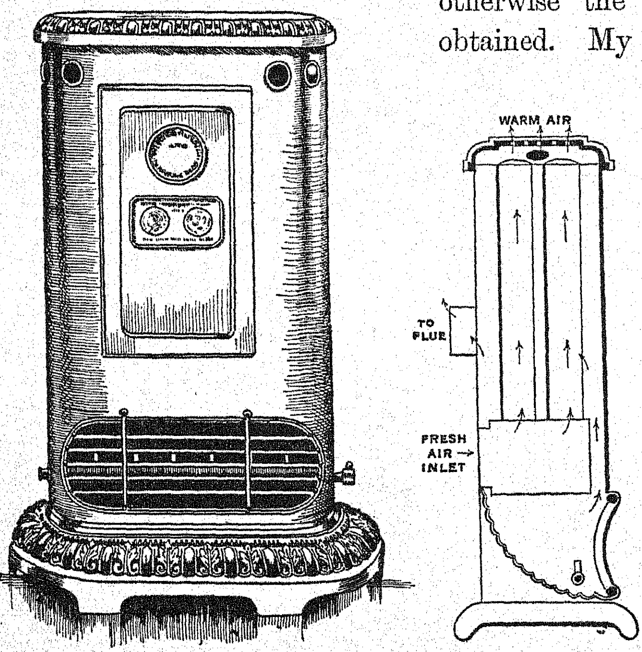


Fig. 480.—View and Vertical Section of Tubular Gas-stove.

The products of combustion of gas consist of water, carbonic acid gases (dioxide and monoxide), sulphur dioxide, and other gases, depending upon the impurities in the gas. Stoves are made which are called "**condensing stoves**", and which depend upon the cooling action of certain surfaces; the vapour of

water produced by the combustion is deposited in the form of drops upon these surfaces, and the water takes up the sulphur dioxide, forming sulphurous acid, and falls down into a special receptacle, which needs emptying frequently. The objectionable smell, usually emitted by a gas-stove unprovided with a flue, is done away with, but the invisible and injurious carbonic acid gases are unaffected and are therefore given off. For this reason, I consider that no gas-stove, whether of the condensing type or any other, should be used without a flue, if proper attention to health is given. The general public appear to believe that a "condensing stove" does away with *all* the products of combustion, but this is an entire delusion. It may, however, be considered that a condensing stove is of no greater detriment to the air of a room than the ordinary gas-burner, used without either special inlet-flue or outlet-flue for the air. This is of course true, but it must be remembered that a stove may consume a far larger quantity of gas than a number of burners; it is also upon the floor, and the heated carbonic acid gas rises easily to the breathing level, whereas, in the case of gas for illuminating purposes, the foul gases are often carried off through the ventilating outlets, which may be near the ceiling.

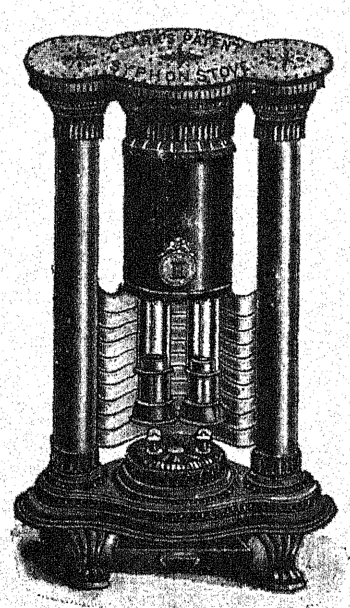


Fig. 481.—"Syphon" Condensing Gas-stove.

Another form of condensing stove, known as Clark's **"Syphon" Hygienic Condensing Gas-stove,** is illustrated in fig. 481. It consists of two Argand burners with the usual chimney tubes, and the particular type illustrated is stated to consume 16 feet of gas per hour, when turned full on, and to heat a room about 18 feet by 18 feet. Below the stove itself is the drip-tray, into which the water falls, as it is condensed. I cannot lay too much stress upon the fact that, although the greater part of the objectionable odour proceeding from the gas-stove without a flue is done away with, yet the large volume of carbonic acid gas is delivered into the room. This stove is intended to be used without a special flue, and some of the advantages claimed for it by the makers are that no flue is required, that no smoke, smell, or dirt, is produced. By the use of a water-vessel, the air can be rendered moist if desired. In passing, I may remark that it is especially desirable in a sick-room, where the patient is suffering from bronchitis, asthma, or other troubles of the respiratory organs, that the air should be moist, and it is usually better to make use of a wet blanket placed

over a chair near the fire, than of a special kettle; the moisture will pass from the blanket readily in the form of vapour.

Flat Stoves have also been specially designed for use under floor-gratings,

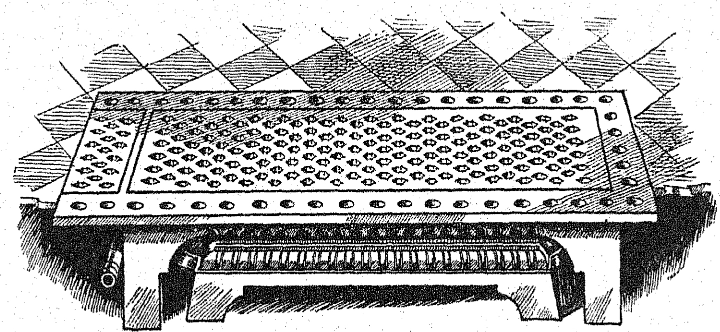


Fig. 482.—Flat Gas-stove for fixing under Floors.

and one of these is illustrated in fig. 482. The same remark applies to such stoves as to those already described, that, unless the products of combustion are carried away by a special flue, they will be found very objectionable.

In May and June, 1906, **the Coal Smoke Abatement Society** tested twenty-five different gas-stoves, which had been temporarily fixed in the new Public Offices, Westminster. Each room had a capacity of about 4000 cubic feet, and all were upon the same floor. All the flues were 68 feet high and 9 inches in diameter inside, and the bottom of each flue was completely closed with sheet-iron, which had an opening just large enough to allow the flue of the gas-stove to pass through. The pressure of the gas was kept constant at $\frac{12}{10}$ths of an inch. Air could only enter the room by the doorway, as each door was fitted with a stop, so that half an inch clear opening was left on the latch side when the door was closed. The tests were directed towards finding out the thermal efficiency of the stoves, and their effect upon the air of the rooms from a hygienic point of view. Each stove was tested for a period of 8 hours continuously, and the results were carefully tabulated, eight of the stoves being finally selected as giving the best results, namely, Cannon Co.'s "Iris" and "Victory" (large); Main's "Chelsea"; Fletcher's "India"; Richmond's "Royal Sovereign" and "Ilford"; and Davis's "Beaufort" and "Albany". The most important conclusions of the examiners may be summarized as follows:—A properly constructed gas-stove with a flue sufficiently large to carry away the products of combustion, although for constant work more costly than a coal fire, is quite as satisfactory from a hygienic point of view, and does not in any way vitiate the air of the room, nor does it produce any abnormal drying effect as is popularly supposed. It is only in the very largest gas-fires that the calorific

value of the fuel burnt approaches that obtained in coal fires; in the majority of cases it is only about one-third. Of this calorific value a higher percentage is utilized in warming the air of the room with the best coal fires than with gas-fires, when once a steady temperature has been attained, the ratio being roughly 3 to 1 in favour of the coal fires. A point in favour of the gas-fires is that they can be easily regulated, and the heat of the room controlled in a way which is not possible with coal fires. The gas used in the eight stoves which gave the best results varied from 23 cubic feet to 66 cubic feet per hour, but this was because the stoves varied greatly in size; the larger ones of course heated the rooms to a higher temperature than was possible with the smaller ones. The air of the rooms was analysed for impurities; to detect carbon monoxide the hæmoglobin test was used, and for quantitative estimation Dr. J. S. Haldane's method was applied. In this test the estimation of carbon monoxide depends upon the intensity of the pink tint produced in diluted blood on shaking it up with air containing carbon monoxide. For other impurities the potassium permanganate test was adopted.

2. *OIL-STOVES.*

Where gas cannot be had from a public supply, oil-stoves are often useful; but the price of oil has now risen so much higher than it was some years ago, that it will be found in most cases much more economical to use coal for permanent work, but where portability is an advantage, the oil-stove has many points in its favour. There are now several very satisfactory stoves upon the market, among which we may mention those known as Rippingille's. The type of burner has recently been improved, and now the flat wick is used instead of the circular. In fig. 483 is shown a large type, known as the "Emperor". The oil-tank is of cast-iron in one piece, and is fitted with two 6-inch burners with patent extinguishers, in separate cylinders; the frames and radiators are of cast-iron, with large mica windows. The stoves are also made with very ornamental cast-iron cases. The same remarks apply to the use of oil-stoves as I

Fig. 483.—The "Emperor" Oil-stove.

have already made with regard to gas-stoves, except that the sulphurous acid fumes are not present, but it is obvious that where so powerful a burner is used without a flue, the amount of carbonic acid gas given off must be very considerable.

A type of so-called **condensing-stove** is also made for burning oil, and, of course, the same method of adding moisture to the heated air can be adopted as was described in connection with the gas-stoves.

CHAPTER IV.

HEATING BY HOT OR WARMED AIR.

Before describing the various systems by which the dwelling-house may be heated by hot or warmed air, it may be well to say that to use this as the sole method of heating, to the exclusion of open fires, will not, in my opinion, commend itself to the average British householder. Rightly or wrongly, **we are so wedded to the system of open fires,** that their cheerful appearance would be greatly missed, and would hardly be compensated by even an equable warmth all over any given apartment. It would, moreover, be very difficult, and in some cases practically impossible, to apply such a system to an old house, although it could easily be arranged for in the design of a new one. There can be no doubt that the mere cost of fuel burnt would be less, if a system of heating by hot or warmed air were applied, instead of the usual system of open fires, but the difference in the cost of fuel on the two systems would not be sufficient in most cases to turn the scale in favour of the hot-air system.

In many parts of the continent of Europe, and in the United States and Canada, the winters are very much more severe, and the variations of temperature much greater, than in the British Isles, and in these cases it is found absolutely necessary to resort to means of heating more efficient than the ordinary open fire, and for this reason large close stoves, placed at some distance from the walls of the rooms, are frequently used; hot-air warming, however, has found wide acceptance in North America, though more, I believe, for public buildings, such as schools, than for private residences.

Before describing the various methods of heating buildings by means of warmed air, it will be well to allude to some of **the principal points which require attention:—**

(*a*) *Cleanliness of the air* is essential, and therefore, if the external air be loaded with soot and dust, it must be passed through some filtering material before being delivered into the living-rooms.

(*b*) *Freedom from disease-germs and noxious gases* is also essential; it is therefore necessary to choose the position of the inlet with careful attention to the position of gullies, ventilators to drains, and apparatus of a similar nature.

(*c*) *Humidity of the air* requires careful attention; the higher the temperature of the air, the more water-vapour it will hold in suspension. It is therefore obvious that, if relatively cold external air be heated and passed direct from the heating-apparatus into the living-rooms, it will be in the best condition for taking up moisture, and, while eminently fitted for use in the drying-closets of a laundry, it is very ill-adapted for breathing, and will necessarily cause the skin to feel parched, and the nose, mouth, and breathing-organs will be made dry and uncomfortable by the abstraction of their natural moisture. It is, therefore, very desirable that the air before delivery into the rooms should have imparted to it the proper humidity necessary to render it pleasant for breathing.

(*d*) *The requisite volume of air* must be passed in at such a velocity as to cause no perceptible draught, and it must then be extracted by a suitable flue of a height calculated to produce the requisite constant flow of air through the building.

(*e*) *The regulation of the temperature of the incoming air* must be provided for by a system of simple valves.

(*f*) *The air must not be heated too much*, otherwise the dust particles will be burnt, and a distinct and characteristic odour will be produced, which is very unpleasant.

In describing the Galton Stove and others of the same type, I have already stated that **dust and other matters** may be carried in with the incoming air. With a system in which the flow of air through the heating-apparatus, and thence through the house, is solely induced by the heated column of air in a flue, it is usually found impossible to obtain sufficient suction to permit of the use of a filtering-apparatus, and therefore recourse has to be had to some means of increasing the draught in the flue, either by the use of a fire at the bottom of it, by the use of a radiator in a similar position, or by mechanical means, such as a rotary-fan. In the Houses of Parliament, which are heated by carefully-humidified air, both fans and fires are used for causing the proper currents of air; but in the case of a house, it is desirable to avoid complication as much as possible, and I should deem the use of a rotary-fan to be undesirable except in a very large mansion.

If air be passed directly through the flue-tubes of an apparatus in which the products of combustion of the fuel play directly upon the tubes, there is always a risk that, by inattention on the part of the attendant, the surface of the tubes may become overheated; and then, instead of being warmed, **the incoming air will be burnt.** The results obtained depend entirely upon the temperature of the heating-surfaces, and upon the velocity of the air.

If the temperature in a living-room be examined at the floor-level, and at different heights above the floor, while artificial means of illumination are being used, it will

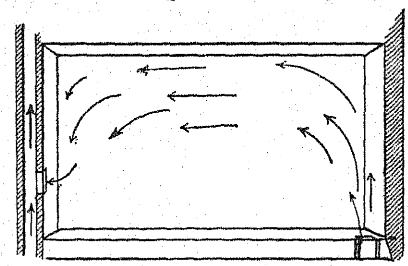


Fig. 486.

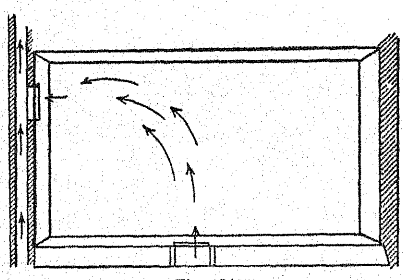


Fig. 484.

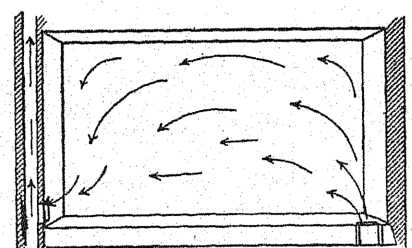


Fig. 487.

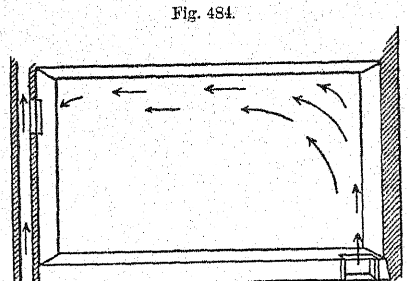


Fig. 485.

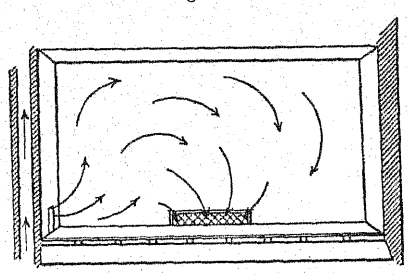


Fig. 488.

Figs. 484 to 488.—Various Arrangements for Entrance and Exit of Warmed Air.

be found that the air near the ceiling is extremely hot and much vitiated by the products of combustion of the gas, oil, or candles used for illumination, and also by the products of respiration. I am of course alluding to the usual arrangement where gas is burnt freely in the air, with no special flues for feeding the gas-jets with external air or getting rid of the products of combustion.

In the United States, **Smead's system of heating by hot air** has been very widely used in public schools and other buildings, and is stated to have given great satisfaction. Before describing this system, I shall borrow from Mr. Smead's work on the subject five illustrations (figs. 484 to 488), showing the results of various arrangements for the entrance and exit of the air. In fig. 484

the heated air enters through a grid, fixed in the middle of the floor, the result being that a column of heated air rises in the middle of the room and passes away near the ceiling, leaving a stagnant mass of cold foul air. The arrangement in fig. 485 is very similar. That in fig 486 shows a slight improvement, while fig. 487 shows direct displacement of all the cold air by the warmed air,

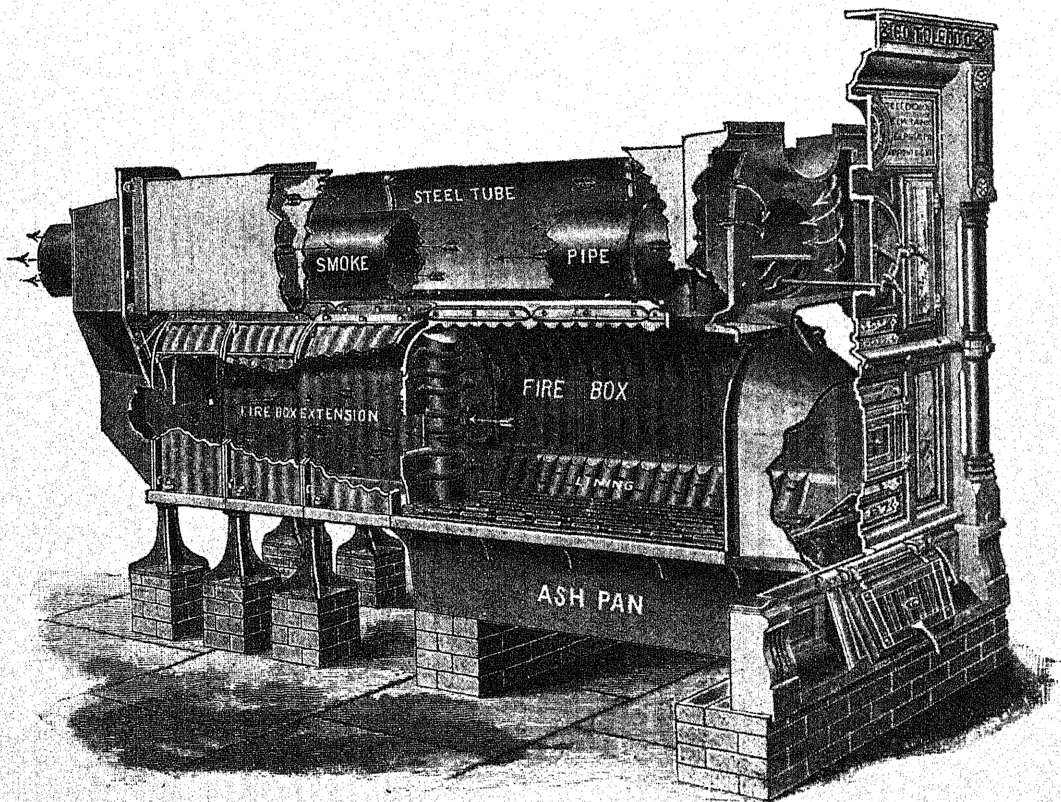


Fig. 489.—The "Smead" Furnace.

and fig. 488 shows an additional improvement by using a number of outlets at the floor-level, and then passing the foul air out between the floor of the room and the ceiling of the room below. It will be observed that no account is taken of the fact, that the products of combustion of the gas in the ordinary way would be taken down to the breathing-level.

In my opinion, there are several objections to the Smead system. One is that the products of respiration, and emanations from the body, which would naturally pass upwards (as they leave the body at a temperature of 98° Fahr.), are carried downwards in the current of air to the outlet near the floor, and the air thus vitiated must be breathed over again, which is undoubtedly a bad feature. The second objection is that, in order to keep a room warmed to

(say) 60° or 65° Fahr., the incoming air must necessarily be at a much higher temperature, probably about 120° Fahr. This current of heated air is most objectionable to any person standing or sitting near the inlet; but this latter objection is not confined to the Smead apparatus, but is common to all systems in which heated air is relied upon as the sole means of warming the rooms.

The Smead apparatus consists of a special type of air-heating furnace, and a system of inlet and outlet flues. The furnace is shown in fig. 489, which

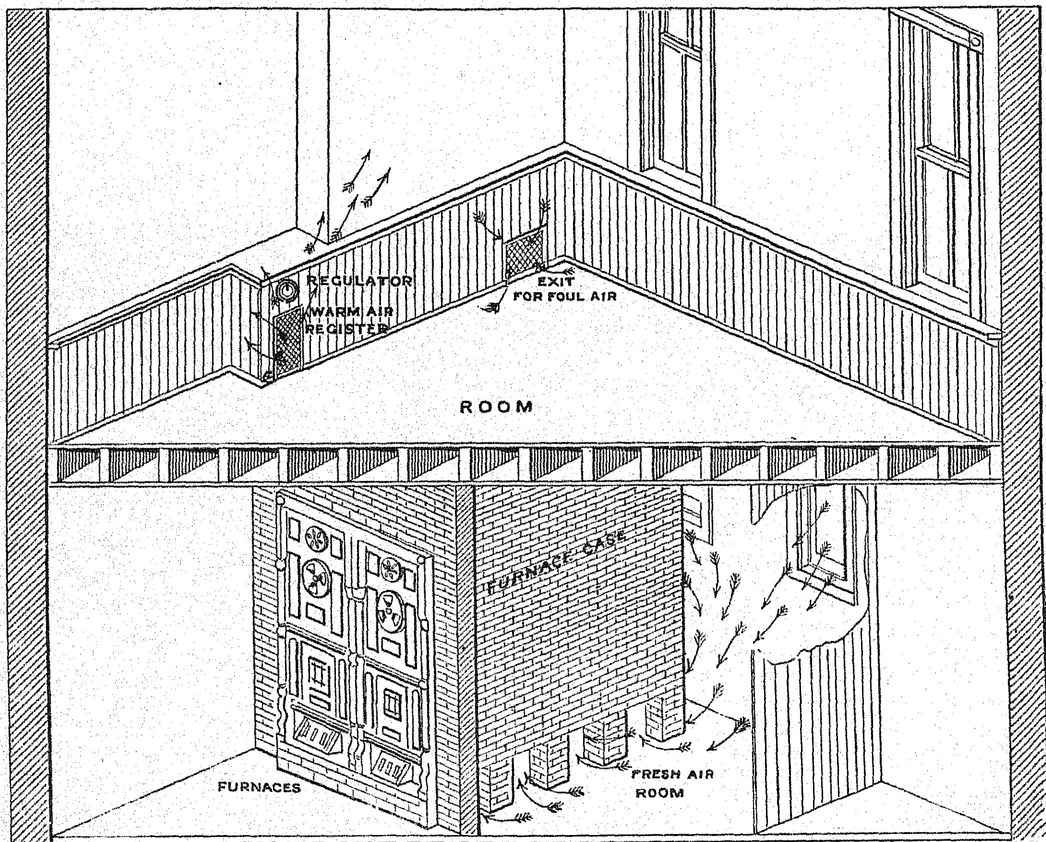


Fig. 490. View of "Smead" Furnace set in Brickwork.

represents a type which has been gradually perfected from a much inferior form. The heater itself is inclosed in brick walls, which form a complete box round it, and it is placed as shown in the perspective view, fig. 490. The furnace is built in a special fresh-air room provided with large inlets from outside. The cold external air enters this room, and is drawn through the openings in the brickwork around the heater; it rises over the highly-heated iron surfaces of the heater, and then passes up the wall-flues to the different rooms. As a rule, one flue is arranged for each room, so that trouble may be avoided from baffling.

The system of inlets is very clearly shown in fig. 494, from which it will be observed that the inlet-flue is carried up a little above the floor-level, and is

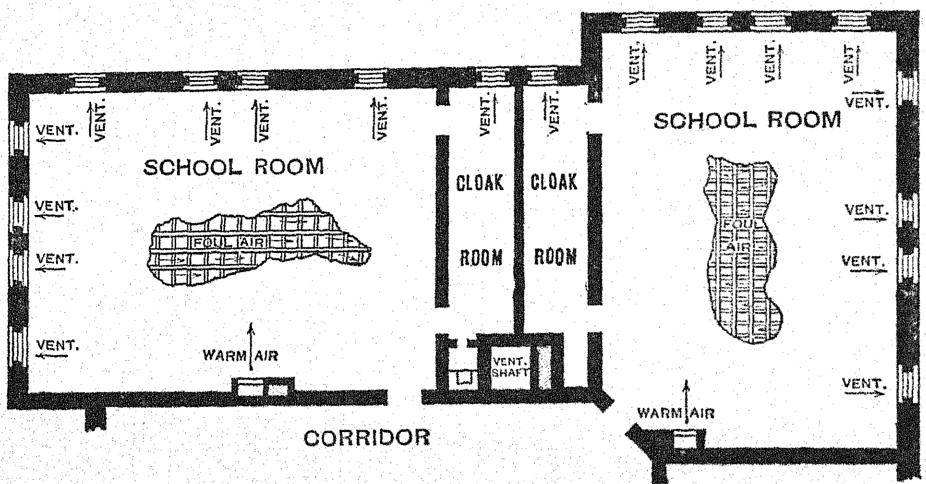


Fig. 491.—General Arrangement of Inlets and Outlets in the "Smead" System.

stopped there; the outlets are in each case close to the floor, in the wall opposite the inlet, as shown in fig. 491, and communicate with the upcast shaft. In plan the shafts are arranged as shown in fig. 492. The smoke-flue is next the ventilating shaft, so that the latter is kept constantly hot; they should be carried to a height above the roof of the building, sufficient to ensure freedom from the baffling caused by conflicting currents.

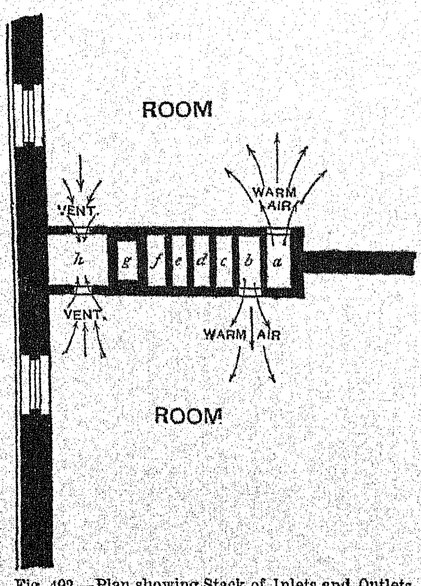


Fig. 492.—Plan showing Stack of Inlets and Outlets, "Smead" System.

a, b, warm air to first story; *c, d*, warm air to second story; *e, f*, warm air to third story; *g*, smoke flue; *h*, ventilating shaft.

The arrangement for the regulation of heat is very ingenious. A view of the register and regulator, as seen from the interior of the room, is given in fig. 493. It will be seen that the register is designed to give the maximum amount of opening possible, and is of very ample size, so that the current of air entering may be of low velocity. Just above the register is placed the regulator, marked for warm air and cold air, and any desired mixture can be obtained by means of a very simple and effective valve, which is shown in fig. 494.

It is quite obvious that if the Smead system of heating is to be applied

successfully to a building, that building must be originally designed for it. The system has been very largely used in the United States, and appears to have there given great satisfaction. A very elaborate work has been published by the Isaac D. Smead Company of Toledo, which is full of coloured plates. The book is well worthy of careful study. The system appears to be very economical in the consumption of fuel, and there can be no risk of explosion as is the case with the use of hot-water and steam plant. The incoming air is not, as a rule, washed or screened in any way, and is passed into the rooms at a temperature of about 120° Fahr. I am not aware that the air is humidified; no mention is made of this in the work alluded to. It is, however, obvious, that to heat air at even freezing-point up to 120° Fahr., without adding to it the requisite amount of moisture, must render the atmosphere in the rooms very dry, and in some cases this may be found objectionable. The mere heat of the incoming air will also probably be found uncomfortable to a person placed near the inlet, although it must always be borne in mind that air at such a temperature, or even higher, will rise in the vicinity of a close stove, and if the current of air passing over a hot-water or steam radiator be slow enough, the air may acquire a temperature considerably higher than that of the general body of air in the room.

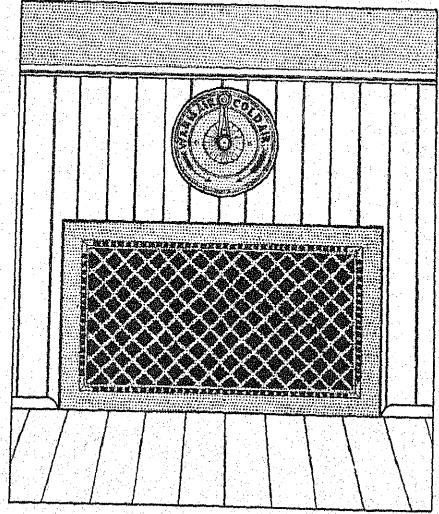


Fig. 493.—View of Register and Regulator.

The Heim System is the invention of Mr. H. Heim, an Austrian, and has been very largely adopted in Austria, Hungary, and other parts of Europe. The system consists of a central heating-apparatus, which is smoke-consuming, and is known as the Calorifer; this heats air brought from the exterior, and the heated air is delivered through specially-formed ducts or flues, prepared in the original design of the building. The same system may, however, be applied to portions of a building, or even to single rooms.

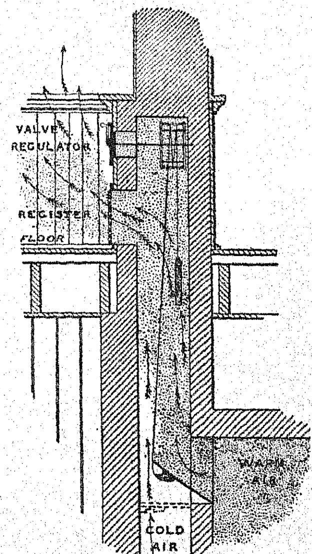


Fig. 494.—Section of Duct showing Valve for Incoming Air.

The arrangement of the Calorifer is shown in figs. 495 to 498. The channel D (figs. 495, 496, and 497) surrounds the grate, and is connected with the outer

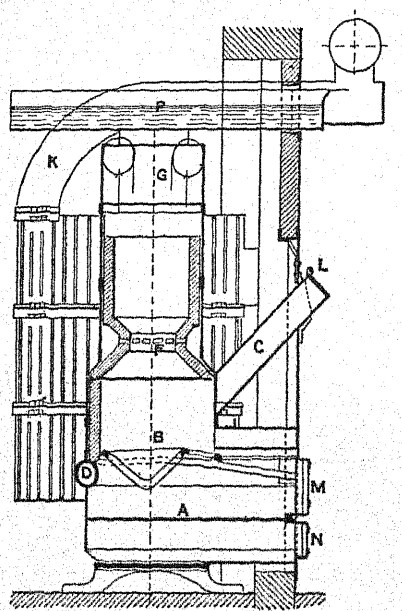


Fig. 495.—Vertical Section of Calorifer from Back to Front.

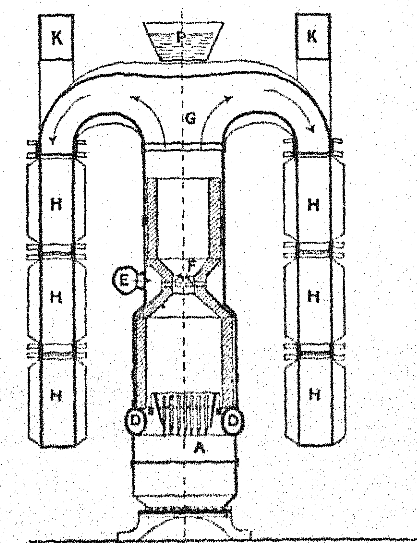


Fig. 496.—Vertical Section of Calorifer from Side to Side.

air, which is admitted and regulated by means of an adjustable valve. This channel introduces heated air under the grate, to ensure perfect combustion. The part of the filling and combustion chambers most exposed to the fire is lined with fire-bricks, which are cone-shaped towards the centre at F (figs. 495 and 496), so as to form, together with the cast-iron outer partitions, one channel, which is connected with the outer air similarly to the channel D. The action of this channel is likewise regulated by means of an adjustable valve. Through this channel highly-heated air is brought in contact with the products of combustion, ensuring a complete consumption of the smoke. Those parts of the combustion-chamber which are not lined with fire-bricks have smooth, ribbed, or fluted sides, according to the heating-surface required. On the uppermost casting of the combustion-chamber there are four nozzles, from

Fig. 497.—Plan of Calorifer.

which the radiators H (fig. 496) are suspended freely, to allow for the expansion and contraction of all parts of the Calorifer, and so avoid the straining which causes loose joints and consequent leakage, so usual in other heating-apparatus. Through these radiators, which are also made smooth or ribbed according to the heating-surface required, the products of combustion are taken first downwards at H, and then upwards again through I (fig. 498), in such a way as to yield the greatest amount of warmth. The smoke-flues K (figs. 495, 496, and 498) are placed on the uppermost part of the radiators, and lead to the front of the heating-chamber, whence they are conducted to the chimney-flue. The doors L, M, and N serve for feeding the Calorifer, for cleaning out the grate, and for removing the ashes. They are made to be air-tight when closed, and remain closed whilst the apparatus is in action. The covers O (figs. 497 and 498) are for cleaning out the radiators. The warm air is kept sufficiently moist by an evaporating vessel P (figs 495 and 496), which projects through the front partition above the Calorifer, and is provided with an indicator. The front of the apparatus is made of strong sheet-iron, and part of it can easily be removed for the purpose of cleaning the radiators, or for repairs. No brickwork has ever to be disturbed. The calorifers are made in various sizes, and their heating capacity is based upon the calculation of heating from 20° F. external temperature.

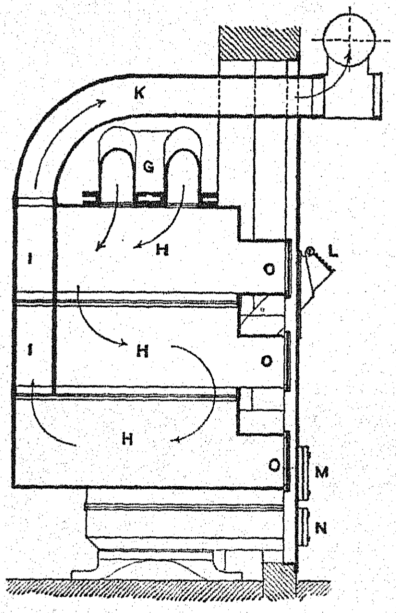


Fig. 498.—Vertical Section through Radiator of Calorifer.

This apparatus is intended to be set in a brick chamber, placed in direct communication with the external air. Some filtering material, such as muslin, can be stretched across the opening, and the heated air passes up the special flues, which must be provided in the building in the same way as for the Smead system. The Heim system differs, however, from that system in having the inlet at a height of about 6 feet above the floor, and in providing two outlet valves into a common flue, one valve being near the floor for winter use, and the other near the ceiling for summer use. A valve is provided in each inlet-flue, by means of which any desired mixture of cold and hot air can be obtained. It will be seen that here there is an attempt to humidify the air, which, I consider, should always be done. In the special pamphlet published by the

makers, reference is made to the fact that the Heim apparatus has been fitted in a number of Austrian royal castles. It is, in my opinion, very desirable (if the valves are only arranged to be either full open or quite shut) that some arrangement should be made for connecting the two outlet-valves together, so that one or other must always be open and the other shut; but if each valve can be regulated for partial or full opening, then that is obviously impossible, and the upper valve should be locked during the winter, and the lower one locked during the summer, otherwise both valves may be left open at the same time, when the ventilation will be imperfect and currents will be set up in various directions.

I have already described the Smead system, which is so well known in the United States, and also a characteristic continental system; it will now be of interest to see how **the same problem has been treated by a British engineer,** Mr. Key, and to note the radical differences between the systems. One of the objections raised to the Smead system by Drs. Drysdale and Hayward, and also by others, was that the direction of the currents of heated air in the rooms was such as to cause the vitiated air to be breathed over again. The objection has not perhaps much force when gas is not being burnt, for it is the practice of the Smead Company in the United States to change the air in school-rooms about six times per hour, and to provide from 1500 to 1800 cubic feet per head.

The Key system is what is known as **the plenum method of warming and ventilation.** The inventor early realized that the external air is so charged with soot, dust, and fog, that it is absolutely necessary to clean it thoroughly before it is admitted into a building; he also found that a dry cloth screen is of little use for the purpose, as it allows the particles to pass through it after a time, and becomes coated with dirt, which in itself may become a source of danger. He thus describes his system. "The air-supply for a building is drawn, by means of an air-propeller or fan, from a point where it is of undoubted purity, and furthest from any possibility of contamination. The entering air passes through an outer warming coil, and then through the air-filtering, air-washing, and humidifying screen. It is then warmed by coming into contact with coils, clustered in batteries within the air-warming chamber. The air passing through this chamber can be instantly reduced in temperature by admitting filtered cold air, through the by-pass doors provided for the purpose, the warm and cold air mixing while passing through the air-propeller. The air is then propelled into the main air-ducts, from which it passes into flues leading to each room. Secondary air-warming coils are placed at the base of each flue, so that the air

to each room may be warmed to any desired temperature while passing through them, and independently of the others.

"The volume of air admitted to each room is directed towards the ceiling, and can be regulated, or shut off altogether. It enters under a slight pressure, and is therefore continuously forcing out the air previously within the room. This may be done at a rate to renew the air of a room from 6 to 15 times per hour, and without experiencing [it is said] the slightest draught. The outgoing air passes off at the floor-level, and is led to roof ventilators, where the outlet air-valves are so constructed as to place the whole air within the building under a slight pressure of about four ounces per square foot in excess of the outside atmospheric pressure at the time. Whether there be no air movement outside, or whether it be blowing a gale, the outgoing air [we are told] flows in a continuous stream, unaffected by calms or gales."

The apparatus for filtering and washing the air consists of several thousand cords of suitable material, stretched from a beam near the ceiling to another near the floor of the air-chamber. When finished, the screen has the appearance of coarse cloth stretched across the apartment. The cords are placed so close that they touch each other; copper wires are laced through the vertical cords in horizontal rows, and being drawn tight, give the screen a flat surface. The rough fibrous nature of the material breaks up the entering air into very minute streams, which pass through equally all over its surface. These screens may, if desired, be formed double, in order to give an extra cleansing or scrubbing surface. The screen is kept moist by water trickling down each cord; and at regular intervals of more or less frequency, an automatic flushing-tank discharges a considerable volume of water down the screen, to remove loose matter which may have collected, and to thoroughly wet the whole surface.

Reference has already been made to the necessity for very careful attention to **the humidity of the air** used for warming, and it will be seen that the temperature of the incoming air, in this system, is first raised, then washed and humidified by the screen, and afterwards further heated by the local coils. It is warmed to a temperature of about 57° F. in passing through the primary air-warming chamber, and no portion of the air is raised above this temperature by contact with the heated coils. Either hot water or steam may be used in the pipes as the heating medium, but the inventor appears to prefer to use steam, as, of course, a somewhat smaller exposed surface will suffice, while at the same time none of the air is "burnt". One of the minor defects of the system appears to me to be the difficulty or impossibility of regulating the degree of humidity given to the air, as the quantity of water passing over the screen is practically constant.

With regard to the general system of **admitting the fresh air at the ceiling,** and discharging the foul air at the floor-level, it may be said that the wisdom of this course depends largely upon the method of illumination. If coal-gas is burnt for illumination in the ordinary way freely in the air, the heated products of combustion naturally rise to the ceiling, and should, in my opinion, be removed thence. Where the outlet-holes are at the floor-level, the products of combustion (including carbonic acid gas, CO_2) must pass down and be breathed. For this reason, I am opposed to the downward system of warming and ventilation in such cases. Of course, if electric lighting be employed, no foul gases are produced by the lighting, and the objection would not hold; there is, however, a certain very small amount of heat produced by the lamps, which would have some little effect in producing or assisting upward currents of air.

Having now dealt with some of the methods adopted for passing warm air in large volumes into the rooms of buildings, as the sole means of warming and ventilation, I shall draw attention to a combined system, devised by Drs. Drysdale and Hayward, in which use is made of **warmed air in conjunction with open fires.** This system is described in their work entitled *Health and Comfort in House Building*. It is an axiom that change of air in a room is essential for health, and consequently that both an inlet and outlet for air must be provided; but no direct admission of cold external air into rooms should be tolerated. Moderately impure air, as pointed out by Dr. Inman, may not be so injurious as a draught of cold air. If the open fire is used, with a separate direct supply of fresh air from outside, this may, and in fact does, check the currents of cold air towards the fireplace, but rather diminishes the value of the ordinary chimney for ventilation. The fireplace should be studied with a view to economy of fuel, and not as a contrivance for the ventilation of rooms.

Drs. Drysdale and Hayward point out that no system of single-room ventilation and warming can be satisfactory, and that a general system is needed; they recommend the use of the kitchen fire as the means of causing the requisite suction, unless a special fire be set apart for the purpose. They also point out that the system of general diffusion of warmth throughout the house does not conduce to effeminate habits, or tend to induce a habit of avoiding exercise in the fresh air, but, on the contrary, is likely to diminish the tendency to bronchitis and quinsy. Supposing, say the authors, that we have provided for the ingress of a sufficient supply of moderately-warmed fresh air for all the wants of the house, and for a sufficient suction to draw off the vitiated air, the next point is to see that this heat is not wasted, and unless special care be taken in the original plan of the house, this waste will occur. As soon as the front door is

opened, the cold air from outside rushes in, and enters the hall, which, as a rule, passes between two sets of rooms direct to the main staircase, and the cold blast rushes through the whole house, tending to reduce it to the temperature of the outer air; the usual plan of an inner door is not always effective, as the outer door is often left open. The back door should open into the scullery or kitchen, or some other room where it is the interest of the servants to keep the door shut; the front door should open into a lobby or vestibule, to which the servants have separate access without going through the central hall of the house; and the windows, they say, should be made fast. The authors are no advocates of warming the house by heated air; all they recommend is the warming of the incoming air needed for ventilation, and this, unless the velocity is great, need not be heated above 65° F. for the comfortable supply of rooms otherwise warmed. It appears that Dr. Gordon Hogg had a house built at Chiswick, in which the authors' plans were carried out, except that no fires were used; within a year or two, however, fireplaces were added, and the windows made to open.[1]

Drs. Drysdale and Hayward consider that the best way of warming is by passing air over hot-water pipes, as this plan avoids burning the air. Two different houses are described. In house No. 1, there are no passages, and the incoming air is warmed by being passed over pipes heated by hot water at low pressure; in the case of the house No. 2, the same result is obtained by the use of small pipes with high-pressure hot water. The authors lay no stress upon the particular means adopted for warming the air, except that they consider that it should be done by surfaces at comparatively low temperature, and not by highly-heated surfaces as in a stove. The humidity of the air is a most important question, and it will not be satisfactory to merely heat the incoming air without paying any attention to its hygrometric condition. Air at 66° F. will hold about 6 grains of water suspended in each cubic foot, while air at 30° F. will only hold 2 grains of water in suspension. I have already pointed out the great objection to passing the air over highly-heated surfaces, as the contact burns and decomposes the particles of dust and organic matter, which are constantly present in the air, thus rendering it unpleasant for breathing.

The authors state that **the primary inlet for the air-supply** to the whole house should be in the basement, or perhaps it would be better to have such an inlet on each side of the building in order to be able to take advantage of the winds; or, to avoid dust and dirt, the inlet might consist of a flue carried up to a point above the roof, where it would be provided with an opening on each of

[1] Drawings of this house appear in Plates XX. and XXI., and a drawing of a somewhat similar house in Plate XXII. Further remarks on the system will be found at the end of Section XI.—ED.

four sides. The incoming air may be screened, washed, cooled, or perfumed according to taste, but it must always be borne in mind that the screening and cleaning operations afford great obstruction to the passage of the air, and it is doubtful, in my opinion, whether the suction of the kitchen-flue would have been so successfully used by the authors, if they had resorted to any of these methods.

They say the best place for the furnace of the warming apparatus is the basement of the stairs lobby, and proceed to describe **the system as applied to the two houses** before alluded to, the kitchen fire alone being used as a means for creating the necessary suction. House No. 2 had a central corridor upon each floor, and these were warmed in the following manner:—The warm air was first led into the ground-floor corridor, from which it passed up through a wide grating fixed in the middle of the ceiling; the air passed through between the ceiling and the floor above, and into the corridor above by a grating at each side running near the wall, as in fig. 499, thence it passed similarly to the corridor above. These corridors thus became sources of warmed air, and the rooms on each side were fed from them by a series of holes, 7 inches long and 5 inches wide, formed in the cornice at the ceiling-level; the shape of the inlets is shown in section in fig. 500, and as many were used as could be got in the length of the rooms. The vitiated air was taken off by similar orifices in the cornice at the opposite side of the room, and it was found desirable to avoid the resistance entailed by causing the current to pass at right angles to its previous direction; to obtain the desired result, the orifices were formed with an easy curve, as shown in fig. 501, the form approximating as nearly as possible to the Schiele curve. The fireplace should if possible be at the side of the room opposite to the inlet of air, and, if convenient, the lower member of the cornice should be hollow for its entire length, and the opening into the room be protected with an ornamental grating.

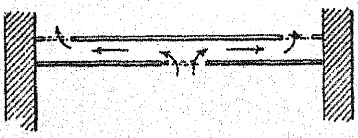


Fig. 499.—Section through Floor of Corridor, showing Passage of Heated Air.

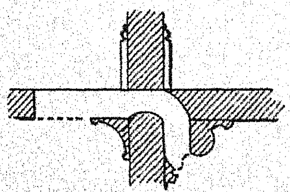


Fig. 500.—Section showing Air-inlet from Corridor to Room.

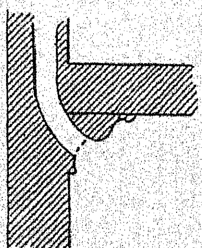


Fig. 501.—Section showing Air-outlet from Room.

The air is let into the rooms at about 65° F., and the authors remark that, when there are living beings in the room, their bodies are at 98° F., and the vitiated air ascends and the incoming warm air descends. Though carbonic acid gas is heavier than air at the same temperature, they consider that there is no danger of its settling near the floor, because

of its small proportion, and the speedy diffusion which takes place between gases.

The flues must of course be as smooth as possible inside, in order to afford the least obstruction to the passage of the air. Each room must be provided with **a separate outlet-flue,** and this must lead direct into a foul-air chamber at the top of the house; all the foul-air flues must come into this chamber at the same level. The foul-air chamber itself was in this case constructed of zinc, and was perfectly air-tight; from the base of this chamber descends the main foul-air flue, and this should go direct to the base of the kitchen-flues. All the passages should be so designed that the velocity of the air travelling along them should not exceed 150 to 200 feet per minute. The authors discuss various methods of creating the necessary suction to get rid of the foul air, but conclude that the kitchen-chimney is the best. The upcast foul-air flue must be separated from the back of the kitchen-fire by a sufficient thickness of fire-brick, and the smoke-flue should preferably be of iron, so that as much heat as possible should be given off to the foul-air flue. They propose that the kitchen smoke-flue should be fixed in the centre of the square foul-air upcast shaft, and that the top of the opening of the smoke-flue should be restricted to 9 inches diameter, which they consider ample, after carefully experimenting upon the subject. If, after trial, the heat evolved by the kitchen-fire is found inadequate, then a few coils of Perkins's hot-water pipes, or some jets of gas, might be added. They have, however, found that in houses of moderate size, the kitchen-fire suffices. The cross areas of the upcast shafts taken together should exceed the cross area of the downcast shaft, and there should be a special valve for regulating the size of the outlet for each room separately. From experiment upon the two houses already alluded to, the authors found that the velocity of air in the upcast shaft was about 400 feet per minute.

In cases where the houses are already built, it may be impossible to use the kitchen-flue as an upcast shaft; it would then be advisable to use gas-jets close to the outlets of each of the rooms, and probably a ring of gas-jets at the top in the foul-air chamber. While the problem of warming and ventilation may have been satisfactorily dealt with by the authors for special cases, it must always be remembered that the two houses referred to were specially designed for the system described, and such a system is not easily applicable to houses already built, with the front and back doors both possibly opening into the main hall or corridor, and both in direct communication with the central staircase.

In the country, the air is usually sufficiently clean to be admitted without filtration, but in towns it is so **loaded with soot and dust,** that some method of

cleansing it is eminently desirable. As soon, however, as filtration is resorted to, considerable resistance will have to be overcome, and I consider that in many cases it will be necessary to resort to the use of a ventilating fan, if certainty of action is to be secured, but such a fan is quite out of the question in a house of small or moderate size, unless an electric motor be used. The employment of electricity for the purpose would simplify the problem considerably, and would render unnecessary the use of the downcast and upcast flues. It is not desirable, however, to be dependent upon the action of such a fan for the warming and ventilation of an entire house.

CHAPTER V.

HEATING BY HOT WATER.

The subject of heating by hot water may be conveniently divided into two parts—*low-pressure heating* and *high-pressure heating*, which will be dealt with separately, as the arrangements of the various parts of the systems differ considerably. The low-pressure system has found by far the greatest favour in Great Britain, by reason of its greater safety and efficiency. The pipes are, however, larger than in the high-pressure system, and therefore the latter may sometimes be preferable. If the apparatus has been once properly installed, it should require very little attention, and an ordinary domestic servant, without any special training, can easily attend to the small amount of stoking required. The apparatus in either case will consist of a hot-water boiler, heated by a fire, gas, or oil, according to the magnitude of the work to be done, and a system of water-circulation pipes, either themselves giving off the heat, or connected with special groups of heating-surfaces known as radiators. Besides this, in the case of a low-pressure apparatus, a special feeding-cistern and pipe will be required, in order that the whole of the system may be kept full of water. In the high-pressure system, such an arrangement is not necessary.

In comparison with heating by open grates or stoves, the systems of heating by water possess the following advantages:—There is only one central fire to be attended to, and this is usually placed in the basement, entirely out of sight, at a point close to the fuel-store. In this way all dirt and dust from the use of coal and the removal of ashes are kept out of the house proper, or relegated to a place where their presence is not so objectionable. As the fuel

can be usually delivered close to the point where it is to be used, the annoyance and trouble caused by the filling of coal-scuttles, and the transport of coal through the living-rooms, are entirely avoided. The temperature of each room can be regulated to any desired degree, and ventilation can be effected quite as easily as by means of open fires. The radiating surfaces can be placed in the best possible position for giving the desired result, and can at the same time be made to counteract the evil effects of draughts produced by badly-fitting windows, &c. Equable warmth over a whole apartment can be obtained without difficulty. With the low-pressure system there is no danger to children, as they cannot possibly be seriously injured, even if they touch the radiating media, although, of course, it is preferable to protect these where very young children are constantly present. If the radiating surfaces are kept at a relatively low temperature, the passage of the incoming air over them will not deteriorate it, as may be the case where the air is passed over highly-heated surfaces, in contact with gases produced by burning fuel.

The position of radiators is a matter of some importance; they are usually placed in front of the windows, so that an upward current of warmed air may be produced, in the very place whence a cold draught usually proceeds. It is, however, preferable to form a special opening through the wall, directly under the window, and to place the radiator in a special case, through which the incoming air is taken. In this way, only warmed fresh air can enter the apartment, and the vitiated air must then be allowed to pass out by some specially-prepared openings. One of the objections to the use of radiators is that the current of warm air, ascending from the heating-surfaces, carries up with it particles of dust from the atmosphere, and from the floor of the room. After a time, this will cause a large black stain upon the wall. This is an additional reason for placing the radiators in front of the windows. In corridors and places of that kind, where such an arrangement is impossible, a shelf with a bracket at each end should be so arranged as to deflect the currents of heated air out from the wall.

One of the chief objections to hot-water warming-apparatus, is that the appearance of the radiators and pipes is not cheerful; and, in Great Britain at any rate, the cheerfulness of an open fire, though accompanied with inequalities of warming, is preferred before the more equable temperature obtained by the use of radiators.

There is no reason, however, why **a combined system of open fires and hot-water heating** should not be used. The flue of the fireplace might then be used as an outlet for the vitiated air, unless gas or oil is being burnt for the

illumination of the room, in which case I consider it desirable to form the outlets close to the ceiling. There are many instances where a hot-water system of comparatively small size and little cost, might be installed in a house, for the purpose of heating the bedrooms, hall, and corridors, while open fires might be retained as a means of heating the sitting-rooms on the ground-floor. With a very small expenditure of fuel, the sleeping apartments might then be kept at a temperature of 55 degrees during the night; and the labour of stoking would be very little, as special boilers are now made which will burn for twelve hours without attention.

1. *THE LOW-PRESSURE SYSTEM.*

The boiler is perhaps the most important feature in any installation, as upon it depends principally whether the system will be economical in the use of fuel, or very expensive.

The number of types and forms of hot-water boilers is very large, and almost every maker has some special design which he naturally considers superior to all others. In Great Britain, boilers are almost entirely made of wrought-iron or mild steel plates, welded into a solid vessel, but in the United States they are very frequently made of cast-iron. This material, however, is not by any means equal to the others, as it is liable to crack when heated, and thus perhaps let loose a flood of boiling water in the basement of the building.

In boilers which are to be used solely for purposes of heating, it is not so necessary to provide ample **facilities for removing incrustation** as in boilers for the supply of hot-water for domestic purposes. A system of hot-water heating consumes practically no water, it being only requisite to allow a supply of a few pints per week to replace the losses produced by evaporation in the expansion tank. The same water circulates constantly, and, having once deposited its impurities, can cause no further trouble with incrustation, while, in the case of a boiler used for hot-water service, the deposit goes on gradually accumulating in the whole of the interior of the apparatus.

It is always desirable, on the score of economy of fuel, **to set the boiler in brickwork,** as the loss of heat by radiation is far less than when the metal exterior of the boiler is exposed to the air. Of course it costs more to build a brick setting than to merely place the boiler on the floor, and for small installations, where first cost is the most important item, it may be advisable to employ a boiler without setting.

Boilers heated by gas are made for use in connection with low-pressure hot-

water apparatus, and will prove useful for small installations. A good boiler of this kind is shown in fig. 502. It has the disadvantage of being made of cast-iron. The cross tubes are cast with the inner body. This boiler is made in two sizes, the smaller being $19\frac{1}{2}$ inches high and $13\frac{1}{2}$ inches from back to front, while the larger is 31 inches high and 17 inches from back to front. The former is said to heat, as a maximum, 40 feet of 4-inch pipe, and the latter 100 feet. The connections are 1 inch and $1\frac{1}{2}$ inches respectively.

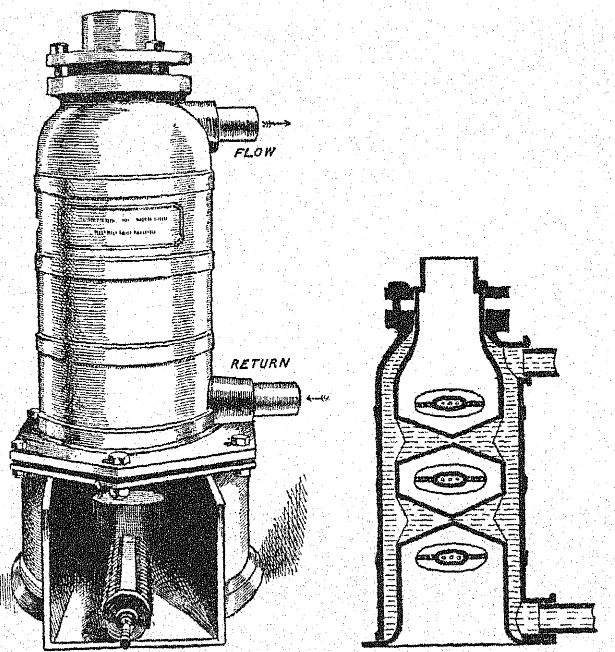
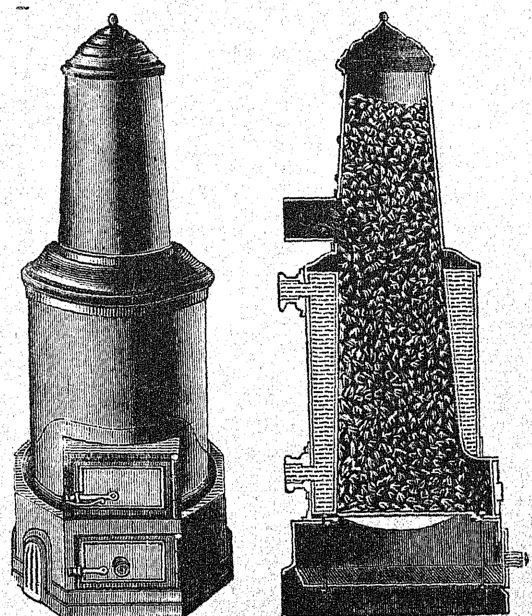


Fig. 502.—View and Section of Fletcher, Russell, & Co.'s Cross-tube Gas Boiler.

Where the amount of pipe to be heated is small, **an independent boiler** of the form illustrated in fig. 503 may be used; this is specially designed so that a large amount of fuel may be fed into it at one time, and the inner part is made conical to prevent the fuel from sticking. Such a boiler would have one 2-inch flow-pipe and one 2-inch return, and would be made of wrought-iron plates welded together. If 4 feet high and 15 inches in diameter, a boiler of this kind will heat about 130 square feet of radiating surface,[1] while one 6 feet high and 24 inches in diameter is estimated to heat about 450 square feet. For a larger installation, such a boiler as the "Marlor", shown in fig. 504, may be used; it

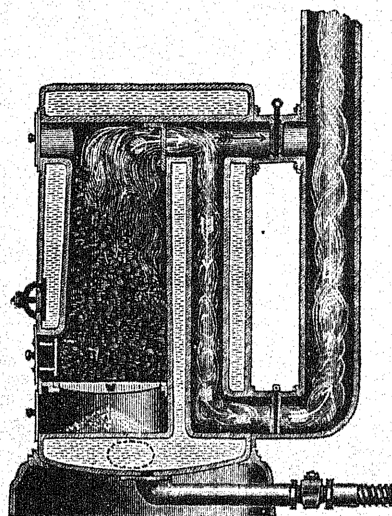


View Section.

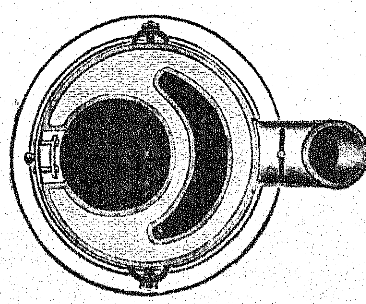
Fig. 503.—View and Section of Independent Conical Boiler.

[1] By "radiating surface" is meant the uncovered external surface of the pipes, radiators, coils, &c., connected with the boiler. Those parts of the system which are not required to radiate heat should be carefully protected with some non-conducting covering.

is made of $\frac{3}{8}$-inch mild steel plates, in various sizes up to 6 feet high and 4 feet in diameter, this size being supposed to heat 2500 square feet of pipe-surface. The smallest size measures 3 feet in height and 2 feet in diameter, and is supposed to heat 450 square feet of pipe-surface. The water, it will be noticed, is carried below the level of



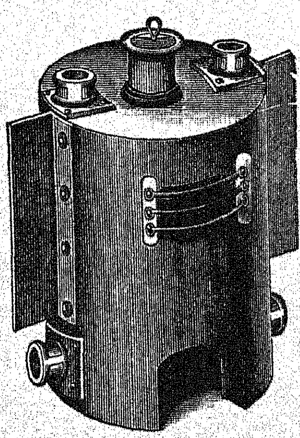
Section.



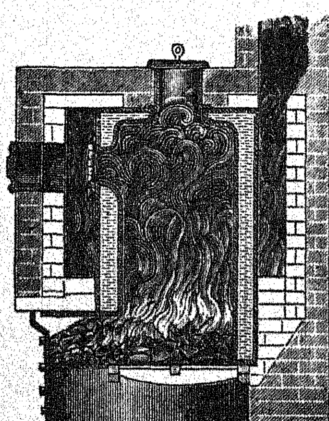
Plan.

Fig. 504.—Plan and Section of the "Marlor" Boiler.

the ash-pan, so that there is a quiet place in which sediment may easily collect, and this can be flushed out at intervals. Such a boiler is, however, somewhat expensive when compared with the types already referred to.



View.

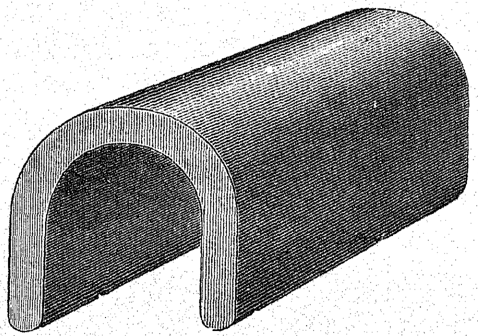


Section.

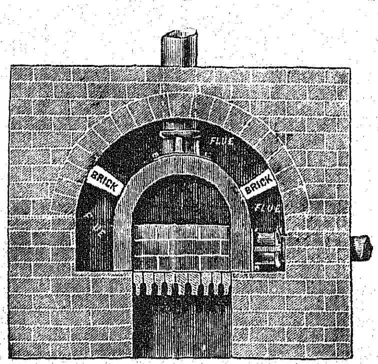
Fig. 505.—View and Section of the "Excelsior" Boiler.

For larger works, it is best to use a type of boiler in brick setting, as much greater economy can thus be obtained. The boiler illustrated in fig. 505 is known as **the "Excelsior" Boiler**, and consists of an external cylinder of wrought iron, into which is welded an inner cylinder of Siemens mild-steel plate. The metal is $\frac{5}{16}$ inch thick, or, for better work, $\frac{3}{8}$-inch. The water-space is brought down to the level of the grate-bar, and the fuel is filled-in through the top hole, and falls on to the grate-bars; the products of combustion rise and fill the inner chamber, then pass out at the front opening (which is protected by cross bars) into the space between the boiler and the brickwork, travel half-way round in

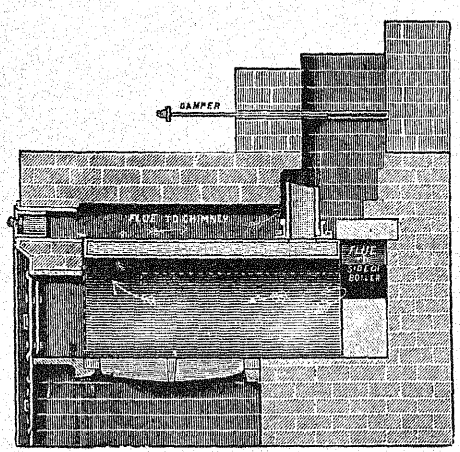
each direction until they strike the baffle-plates, under which they pass, and then proceed round the back of the boiler to the flue. It will thus be seen that the products of combustion surround the water-chamber on all sides. In the illustrations, two connections are shown at the top for the flow-pipes, and two inlets at the bottom for the returns. Such a boiler, measuring 24 inches in height by 18 inches in diameter outside, is capable of heating about 350 square



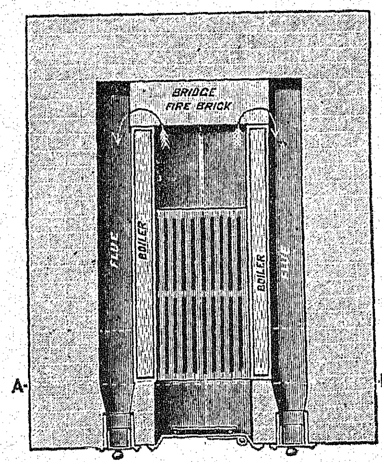
View.



Section on A B.



Longitudinal Section.



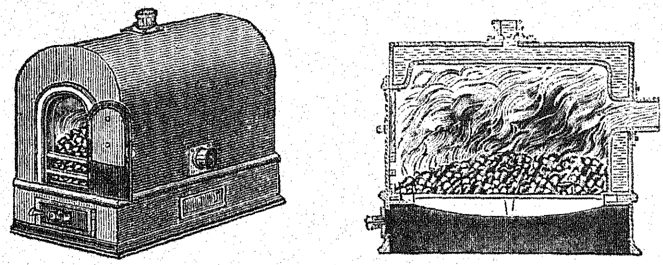
Plan

Fig. 506.—Plan, View, and Sections of Simple Saddle Boiler.

feet of radiating surface, while a boiler 36 inches high by 26 inches in diameter will heat about 825 square feet of radiating surface.

The boiler which has found the greatest favour—owing to its very simple form—is **the plain saddle boiler,** shown in fig. 506. This is made of welded wrought-iron plate, $\frac{5}{16}$ or $\frac{3}{8}$ inch thick, and is so set that the products of combustion play all over its inner and outer surfaces. The plan and sections of the setting show very clearly how this is accomplished. The flames play upon the inner part of the boiler, and the gases then pass to the back, return by the sides

to the front, and pass over the top of the boiler to the flue. The flues on the top of the boiler are not of much use as heating-surfaces, but the heat is radiated off the brick arch; the side flues are of much the greatest efficiency. If coal be burnt in a boiler of this class, the flues should be constantly swept out to maintain the boiler in its highest efficiency. Such a boiler, 48 inches long, by 22 inches by 19 inches over all, is expected to heat about 640 square feet of radiating surface. Saddle boilers can be obtained of smaller size, made in the independent form, that is, to be used without brick setting, as shown in fig. 507. This cannot, of course, be so economical as the others, as the whole of the exterior of the boiler is exposed to the air, and the flames pass direct to the flue. The loss of heat from the exterior could be diminished by coating the boiler with non-conducting composition. The saddle boiler may be made as shown in fig. 508; the return-flue then passes back inside the boiler, and therefore more use is made of the waste gases. The cost of such a boiler is, however, higher.



View. Section.

Fig. 507.—View and Section of Independent Saddle Boiler.

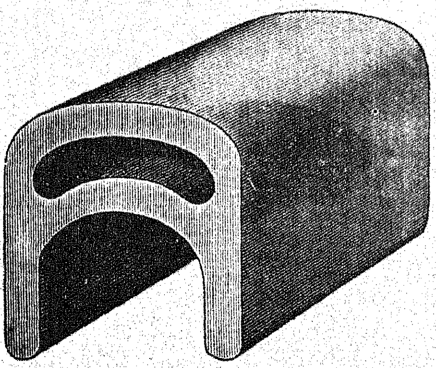
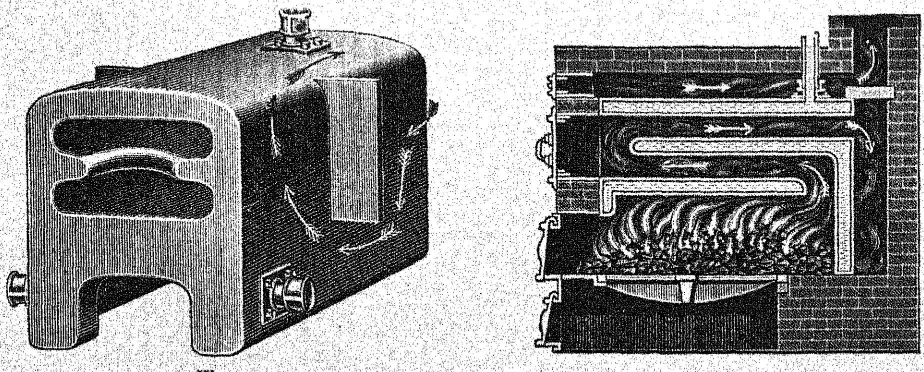


Fig. 508.—View of the "Devona" Saddle Boiler.



View. Section.

Fig. 509.—View and Section of the "Edina" Boiler.

The boiler illustrated in fig. 509 is a comparatively new design, in which the

products of combustion are passed round a great many times before finally reaching the flue. Economy in fuel is obtained, but the first cost of the apparatus is considerably greater than that of a boiler of the plain saddle form.

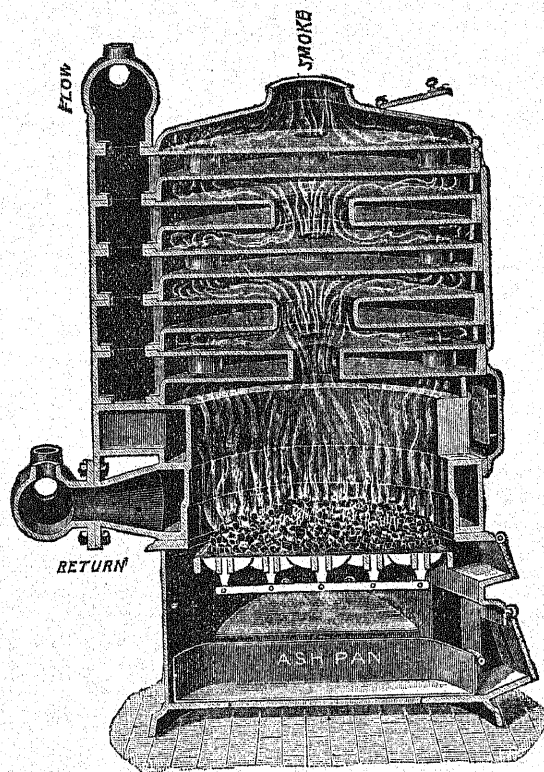


Fig. 510.—Vertical Section of the "Oxford" Cast-iron Boiler.

Cast-iron Boilers.—The Gurney Foundry Co., Ltd., of Toronto, Canada, make two types of boiler. A section of the larger type, known as the "Oxford", is given in fig. 510, and the separate portions of which the apparatus is built in fig. 511. This "heater" is built upon the theory of directed circulation: thus, the water entering at the return heater (which is on the level of the fire-pot instead of in the ash-base) is passed to the front of the fire-pot at the bottom, and over a diaphragm which runs through the water-chamber of the fire-pot, and then back to a point above the point of entry. It is there conducted into the first section above the fire, through two openings, which run continuously from the fire-pot to the top section

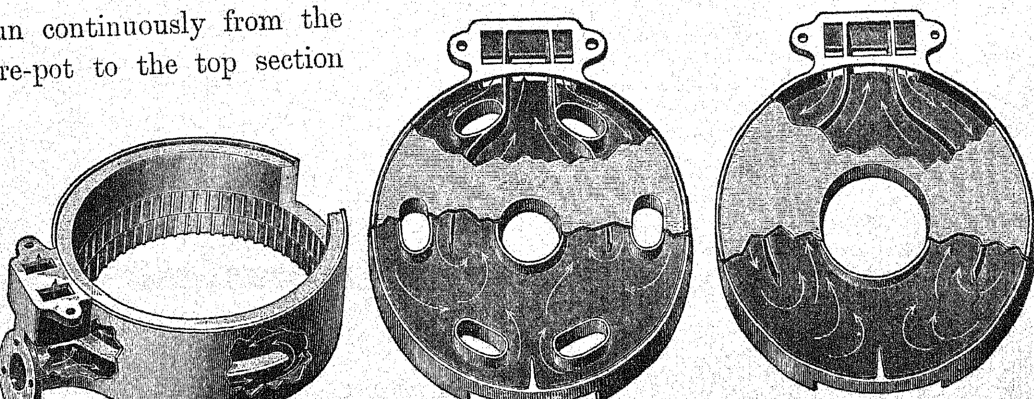


Fig. 511.—View of Fire-pot and two Rings of the "Oxford" Boiler, showing circulation of water and back connection.

of the heater. These two side openings deliver the water on the respective sides of each section of the heater to a chamber which runs to the centre,

to a directing diaphragm, and the two streams are thence thrown back again to a central opening, which is open to the top of the heater, and upon which the flow-heater is placed. The circulation in each of these sections is independent of the other. The theory is, that, while there is no doubt that a directed current over a warm plate is only heated on its outer edges, the agitation and interior circulation in the liquid itself present many surfaces during the time the liquid is passing over the heated surface.

At first sight the heater seems somewhat complicated, but it appears to give extremely good results. There will, of course, be loss of heat from the exterior, and this cannot well be counteracted by the application of non-conducting composition, as it would interfere with the joints. A boiler of this kind, measuring $42\frac{1}{2}$ inches in height and 22 inches in diameter, is rated to be capable of heating about 170 square feet of radiating surface, and as this is the rating used in Canada, it is considered well within the mark for the much more temperate climate of the British Isles.

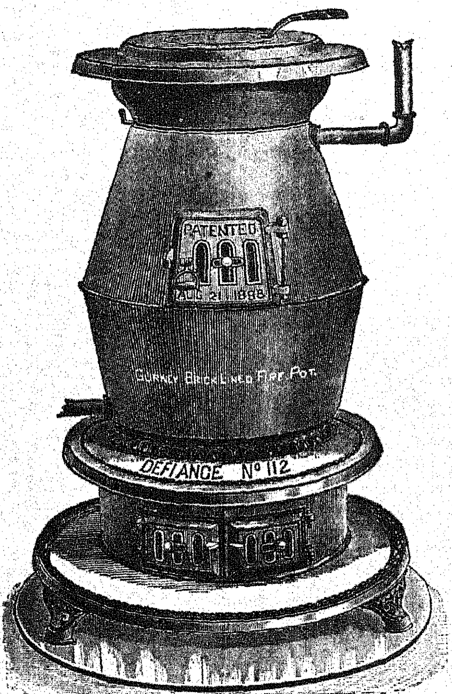


Fig. 512.—View of the "Defiance" Cast-iron Boiler.

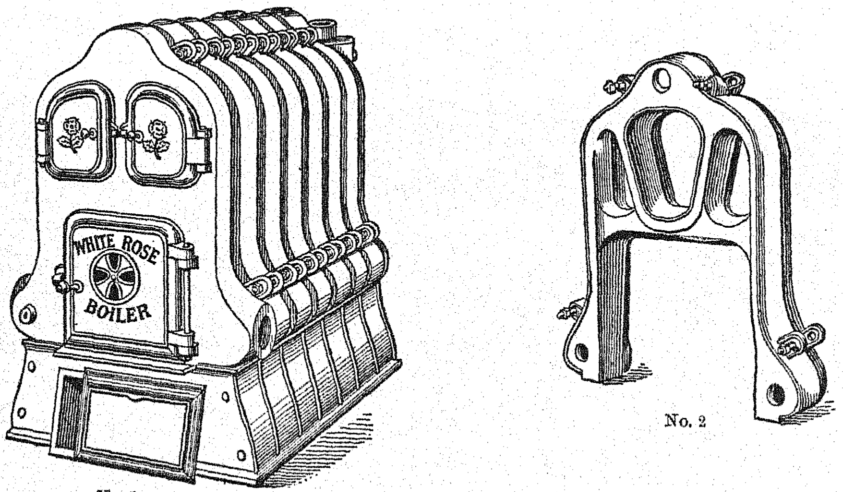
The Defiance Boiler (fig. 512), by the same makers, is intended for small powers.

The "White Rose" Boiler (fig. 513), made by Messrs. Hartley & Sugden, is a cast-iron boiler with the sections arranged vertically and bolted together. It has been extensively used, and is made in a great number of sizes.

The boilers made by Mr. James Keith are also of cast-iron. The type known as **the "Viaduct" Boiler** is illustrated in fig. 514. These require no brick-setting whatever, the cast-iron exterior has a fire-brick lining, which is, in my opinion, a distinct advantage over the Canadian form, as the heat will be radiated from the glowing surface, and it is practically impossible for the exterior of the heater to become red-hot, as may easily happen in the case of the Canadian type. The shell is made in two pieces, which are held together by bolts. The stoking-door is immediately under the crown of the arched water-way, and consequently a large amount of fuel can be inserted, and the fire will burn for a long time without attention. A clinker-door

is provided immediately over the grate-bars, and an ash-door below. There are in the figure two outlets for the flow-pipes, and two inlets for the returns. This type is made in sizes with heating capacities up to 1500 square feet of radiating surface.

The surface required in an ordinary house will not usually exceed this figure, but if it does, another more powerful boiler by the same maker may be used; it is known as **the "Challenge" Boiler,** and is illustrated in fig. 515. This boiler has horizontal or nearly horizontal sections, somewhat similar to the Gurney boiler, but, instead of horizontal baffle-plates, cross tubes run from back to front.



No. 1 No. 2

Fig. 513.—The "White Rose" Cast-iron Boiler
No. 1, View; No. 2, Middle Section showing Flues.

It does not appear to me to be designed so as to baffle the upward currents of heated gases as effectually as the Canadian type, but the deposition of soot upon horizontal surfaces must always be very considerable, even when the boiler is cleaned out frequently, and this would detract from the value of the Gurney boiler.

In order to avoid loss of heat from the external surface of these and other independent boilers it is desirable to coat them thickly with some good **insulating material** such as asbestos, magnesia, or fossil-meal. The material is applied in its plastic state while the boiler is hot, and it is desirable to put on the first coat roughly, then to fix wire netting or some similar support which will form a key for subsequent coats, and so hold the covering in position and prevent it cracking off. The surface of the covering should then be well painted, or canvas may be fixed first and then painted. All the main pipes in the base-

ment should be covered in the same way in order to economize fuel. It is usual to employ coke as the fuel, and the fire can easily be banked up at night.

An interesting type of boiler, resembling the boilers used for high-pressure hot-water heating, is made by Messrs. Renton Gibbs & Co., Ltd., and is

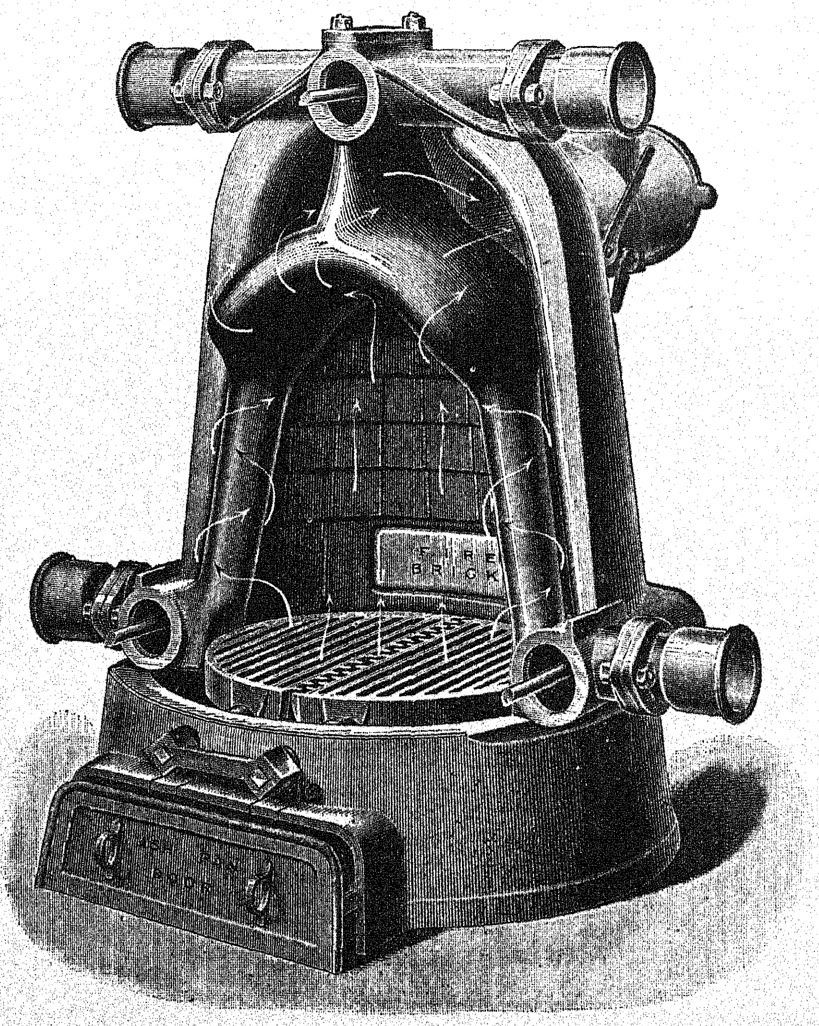


Fig. 514.—View of "Viaduct" Cast-iron Boiler, with the Front Half of the Outer Case Removed.

illustrated in fig. 516. It will be observed that the boiler really consists of a series of coils of pipe, placed in a fire-brick chamber; part of the tubes form the grate-bars, and the flame plays directly on to the upper tubes. The flow of water produced in the tubes is, of course, extremely rapid.

Körting's Boiler is shown in figs. 517 and 518. It is designed for low-pressure steam heating, but we describe it here, as a very similar type is also used for hot-water heating. The following description is taken from the maker's list.

"As the boiler is provided with an open stand-pipe ST, there is absolutely no risk of explosion,[1] and the position occupied by the boiler may be decided without reference to the question of safety. As furnace, which serves at the same time as hopper and as fire-grate, we have adopted our patent cast-iron ring tubes (see D, fig. 518), which are filled with water, and are connected at the bottom and top to the water space of the boiler. By removing the cover F on the top of the boiler, the hopper and furnace may be filled with fuel. It is preferable that, where possible, coke or anthracite coal should be used. The air for combustion passes through the draught-regulator, and a flue in the setting of the boiler, to the front of the furnace. As the furnace-door is kept closed, except when the ash is removed, and with closed door the connection between the front of the furnace and the ash-pit is hermetically sealed, the air on its way to the boiler must pass between the water-tubes of the grate, and through the fuel inside the grate. When the furnace-door is opened for the removal of ash, cold air passes direct through the ash-pit to the boiler, checking the draught, and diminishing rather than increasing the combustion in the furnace during the time the door is open.

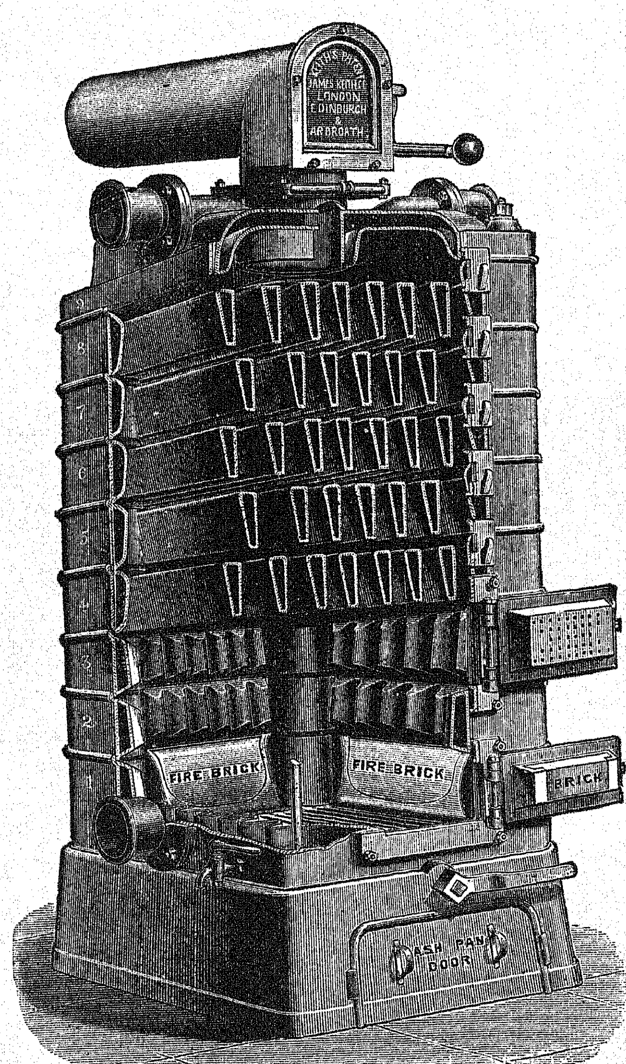


Fig. 515.—Sectional View of the "Challenge" Cast-iron Boiler.

[1] But suppose that the water in this is frozen (as may readily happen if the apparatus is only used on certain days of the week), and the water in the circulation-pipes is also frozen, so that relief cannot be obtained through the air-pipes, then an explosion will be almost a matter of certainty if the fire is lit.—ED.

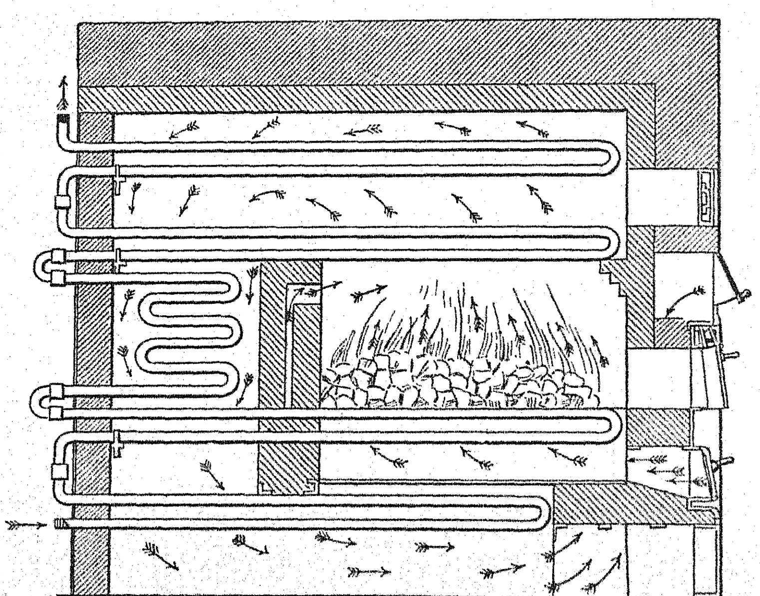


Fig. 516.—Section of the "Renton Gibbs" Tubular Boiler.

The danger is thus obviated that the combustion should be too intense if the furnace-door is inadvertently left open.

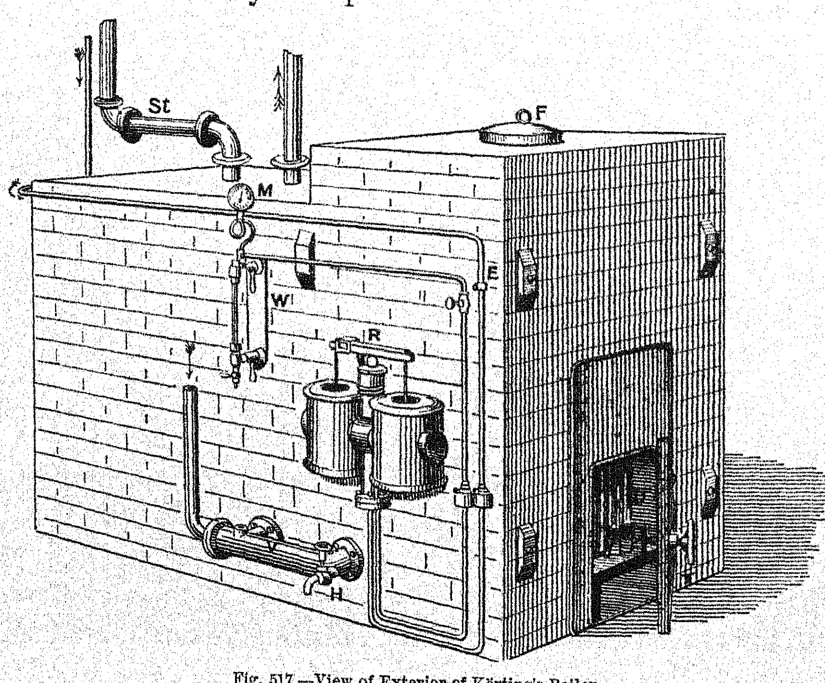


Fig. 517.—View of Exterior of Körting's Boiler.

T, furnace-door; D, patent grate; F, fuel-hopper; R, draught-regulator; M, pressure-gauge W, water-gauge; H, draw-off cock; V, connection of boiler with water-tube grate, and condensed-water return-pipe; ST, stand-pipe, 16 feet high; E, valve for clearing safety-pipe of water.

"The advantages of the arrangements for firing, as roughly sketched, are

that the combustion of the fuel is exceedingly perfect, and the generation of smoke so small that the problem of smoke-prevention is fully solved; the fuel, which is contained inside the water-tubes, has no direct contact with the brick-work, and repairing or renewal of the boiler-setting is rendered almost unnecessary; and lastly, accumulation of clinker does not form, as the hot clinker suddenly contracts on coming in contact with the comparatively cool surface of

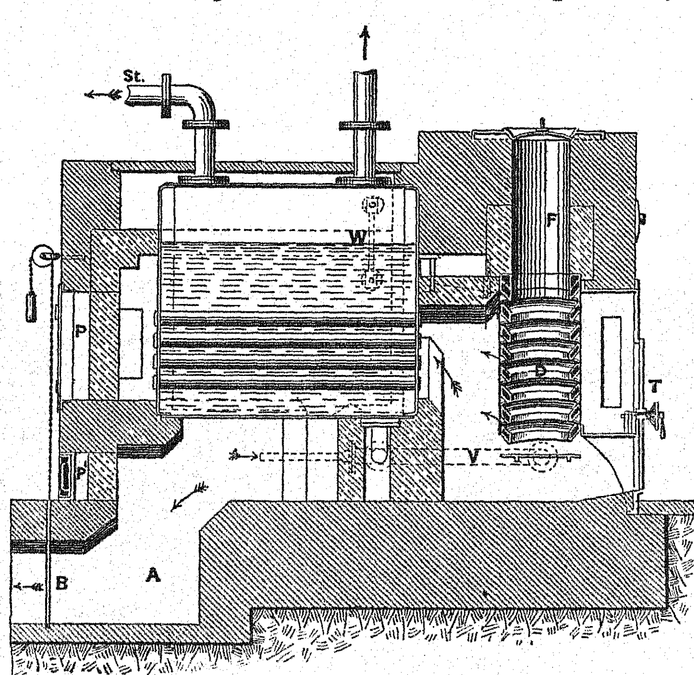


Fig. 518.—Section of Körting's Boiler.

the water-tubes, breaking into small pieces, which readily find their way into the ash-pit.

"The filling-hopper F can be made of any size to suit the kind of fuel in use, and may be sufficiently large to contain two days' supply of fuel. We are making these boilers in ten sizes of from 40 to 400 square feet of heating-surface, and are prepared to make larger ones if required. The attendance required for one of these large boilers is naturally much less than is needed in other systems of heating, where several smaller boilers are used. The work of the attendant is confined to re-filling the hopper F with fuel, which is only necessary at long intervals, and to removing clinker and ash two or three times a day, so that we may claim to have reduced the attendance to a minimum.

"The maintenance of a constant pressure is of special importance with low-pressure steam heating, and we have designed an **Automatic Draught-regulator**

(shown in section in fig. 519) by which this is perfectly secured." This apparatus will be more particularly described in the chapter on heating by steam.

Lack of space prevents detailed description of every kind of boiler, but probably sufficient has been said to give the reader some idea of the principal types now in use. We must now pass to the consideration of another and most important part of a hot-water apparatus, namely, the radiator.

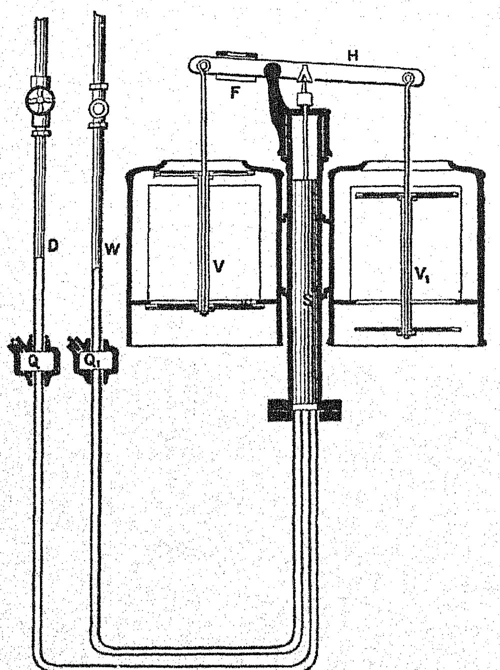


Fig. 519.—Section of Körting's Automatic Draught-regulator.

Q Q_1, vessels containing mercury; D, steam-connection to boiler; W, water-connection to stand-pipe; S, float; H, lever-arm; F, movable weight; V V_1, valves for regulating the admission of air.

Radiators can generally be used either with low-pressure hot water or low-pressure steam; the subject will be best treated here, and need not be referred to in subsequent chapters.

The simplest form of radiating-surface consists of **a straight length of pipe,** which may be, of course, either wrought-iron or cast-iron. Where appearance is no object—as possibly in the basements of buildings and servants' bedrooms—cast-iron pipes are perfectly suitable, and the method of arranging them is shown in plan in fig. 520. The pipes may be two, three, or four inches in diameter, and made with plain socketed joints, or with special joints as shown in fig. 521. The latter is known as Richardson's expansion-joint, and possesses several distinct advantages. The joint is held together by bolts, and an india-rubber washer is put between the two ends of the pipe. If a length of pipe requires to be shortened, the socket end is cut off, and its place taken by a loose flange, held securely in position by a toothed gland, which grips the pipe and prevents slipping. This type of pipe is somewhat more expensive in first cost than the ordinary socketed variety, but the great facility with which joints can be made renders it little more expensive

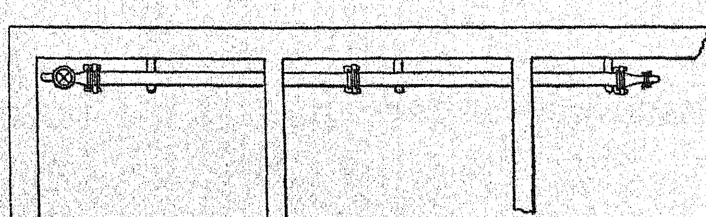


Fig. 520.—Plan of Hot-water Pipe

when fixed. Straight pipes require to be held either above the floor on small stools, which should be provided with rollers (to allow of expansion) of the form shown in fig. 522, or they should be supported on wall-brackets as shown in fig. 523, or hung by slings from wall-

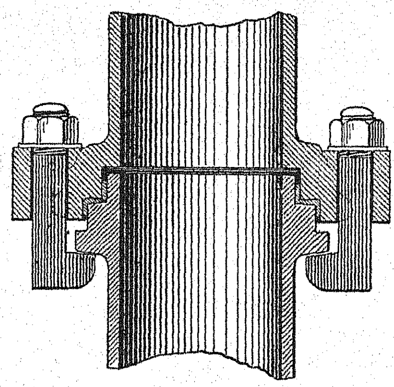


Fig. 521.—Section of Richardson's India-rubber Expansion-joint.

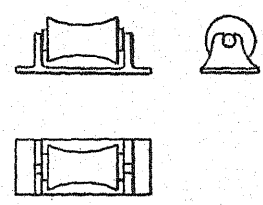


Fig. 522.—Front and End Elevations and Plan of Roller Stool for Pipes.

brackets as shown in fig. 524. They may, however, be supported on simple brackets of T-iron, bent into the form of a hook, and let into the wall, as

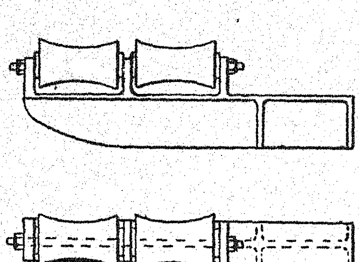


Fig. 523.—Elevation and Plan of Roller Bracket for Pipes.

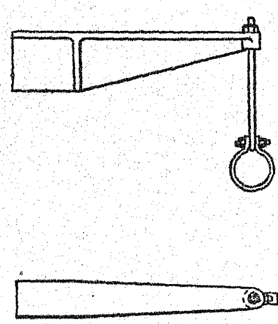


Fig. 524.—Elevation and Plan of Bracket and Sling for Pipes.

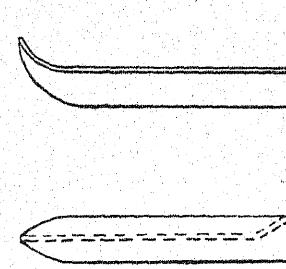


Fig. 525.—Elevation and Plan of T-iron Bracket for Pipes.

shown in fig. 525, and this arrangement is quite sufficient where the lengths of pipe are not very considerable.

There are many cases where pipes of this character would be an eyesore if carried above the floor, but there is a system of placing the pipes in a specially-formed **trench covered with a metal grating.** There are great objections to this system, as the trench forms a most convenient receptacle for dirt and dust and the sweepings of the floors, and, while harbouring vermin, may be the source of infection. This system is shown in the right-hand part of the ground-floor in fig. 526.

If the pipes are carried round the rooms in a **channel formed behind the skirting-board,** and protected by a metal grating, there is not so great an objection; this method is shown in the left-hand part of the ground-floor in

fig. 526 and also in 527. The channel above the floor, however, entails certain difficulties, as the pipes cannot well be carried below the doors, as in that case a dip would be formed, which might interfere with the circulation. In order to avoid the difficulties specified, it is found usually more convenient to place the main pipes between the floor of the room to be heated and the ceiling of the room below. These pipes are preferably carried in a special trench covered with a screwed board, so that access may be obtained to them. If the pipes are thus carried below the floor, it is merely necessary to bring from the main loop short branches to form the inlet and outlet of any particular radiator.

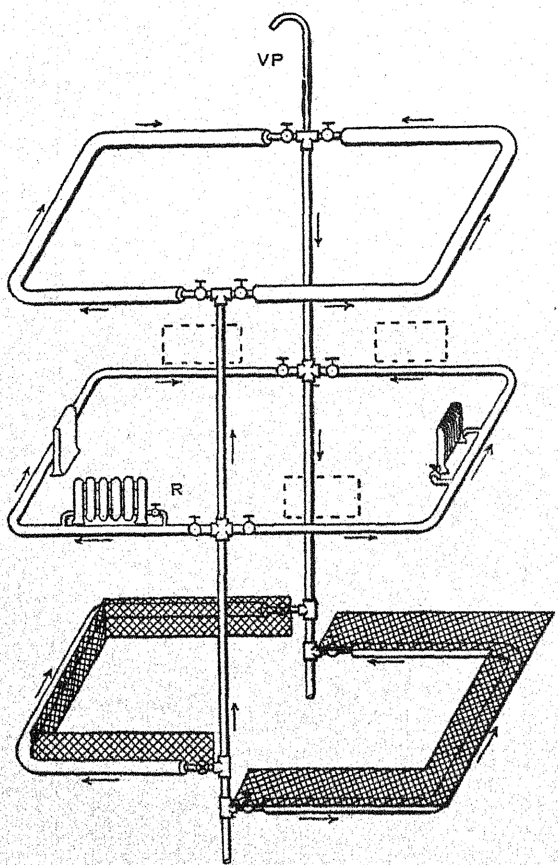


Fig. 526.—Diagrammatic View of Low-pressure Hot-water Pipes R, radiator; VP, vent-pipe.

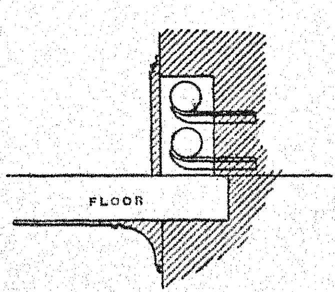


Fig. 527.—Pipes in Channel formed in Wall.

It is preferable to clothe the whole of the pipes where they are not needed for radiating heat, with some **non-conducting material,** such as slag wool, asbestos, magnesia, &c.

Formerly **a very common type of radiator** consisted of two vertical " ends ", connected together by a number of horizontal tubes. These coils were usually set close against the wall, but in certain cases were fixed in the middle of entrance-halls, landings, and places of that nature.

These coils have now been practically superseded by **a type having vertical loops,** fastened together in groups of convenient size. The loops are made of different sizes, double, treble, quadruple, &c., and of different lengths. The end

loops are usually provided with feet, and the several parts are shown in fig. 528, which represents a type of radiator known as the Safford; it is manufactured in Canada. A similar radiator is made by Mr. Keith, who has previously been alluded to. In this, each intermediate loop is an exact duplicate of the other, one side of each boss being tapped with a right-hand thread, and the other with a left-hand thread. The loops are then connected together by means of left and right nipples. In some cases the faces of the bosses are carefully machined, so that no packing other than red-lead cement is needed in order to make a tight joint, and in others a washer of paper soaked in boiled oil is employed.

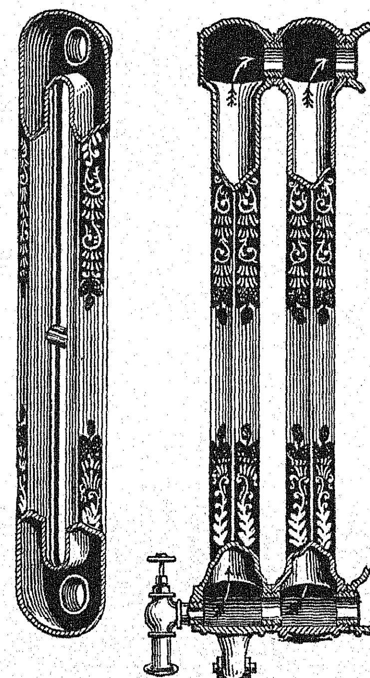


Fig. 528.—Section and View of parts of the "Safford" Radiator for Hot Water.

There are some radiators which are **held together by long bolts.** In my opinion these are distinctly inferior to the kind just described, as the bolts expand and contract, and allow of leakage.

The Coil Radiator, represented in fig. 529, is made by Messrs. W. G. Cannon & Sons, and has been specially designed to afford a large heating-surface in small compass. There is a main bottom pipe, and connected to this are spiral coils of copper. Each coil is free to expand vertically without reference to any other coil, and although such a radiator is more expensive than the ordinary cast-iron type, it is very efficient in working. The coil is shown with a connecting tube at the top, as well as at the bottom,

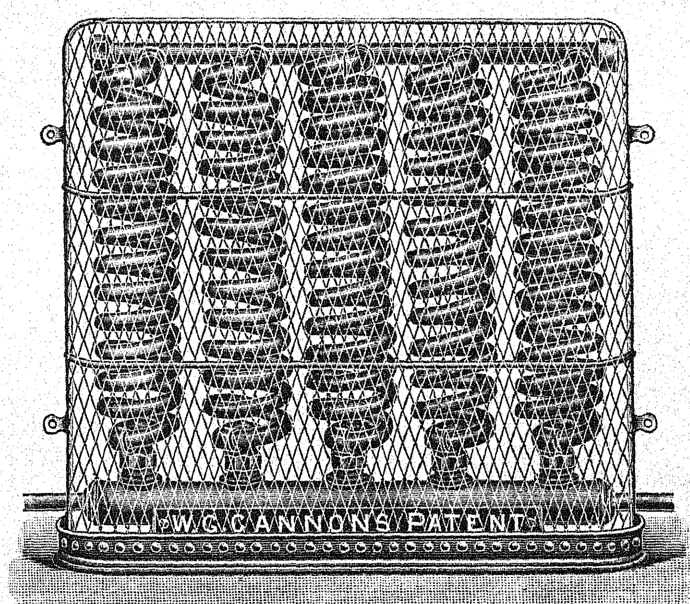


Fig. 529.—Coil Radiator, with Wire Guard.

and the whole is protected by a wire guard, to prevent children from burning their fingers. The same type is also made inclosed in a cast-iron case with a door for access, and hit-and-miss gratings on the top and in front, as shown in fig. 530. There is also a hit-and-miss grating behind, affording access for the external air, which passes out through the upper grating into the room.

I have already drawn attention to the desirability of **warming the incoming air** which is used for heating and ventilation, and the present is a fitting opportunity for pointing out several methods by which this result may be obtained. As shown in fig. 530, a special air-inlet must first be provided in the external wall, and the inside of this opening should be carefully rendered with Keene's or other hard cement. The exterior face of the opening should be protected with a cast-iron grid, which is so fixed in its frame as to be capable of easy removal, when the inside of the opening is to be cleaned. The inner face of the inlet should be provided with a suitable hit-and-miss grating, and the inlet itself should be as near the floor-level as possible; this hit-and-miss grating must be capable of adjustment by means of a handle, which comes to the outside of the case either at the side or at the top. The case itself, which is usually of cast-iron, may be made as ornamental as may be desired, but it should have a hit-and-miss grating of ample size on the top, and also at the front close to the floor. The action of the radiator and case is as follows. In mild weather the inlet-grating is opened to its full extent, the front grating in the case closed, and that in the top of the case opened wide. The heat of the radiator causes an upward current of air through the upper grating, and the external air passes in to take its place. The warmed air passing into the room will have a temperature dependent upon the temperature of the radiator, and upon the velocity of the air passing through the external wall. If now it be found that the volume of air entering the apartment is too large, the grating at the inlet may be entirely closed, and the grating in the front of the case opened. Air from the floor-level of the room will then be drawn into the case, and will pass upwards among the coils of the radiator, and out into the room through the top grating.

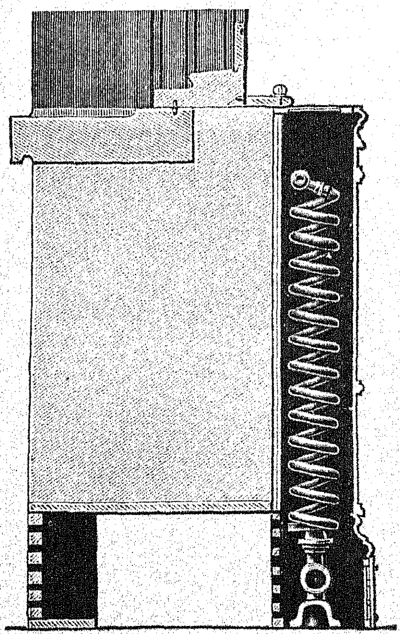


Fig. 530.—Section showing Coil Radiator in Cast-iron Case, with Air-inlet, &c.

There will, in that case, be a circulation of the air in the room only, and the outlet-ventilator, at the ceiling or the floor-level as the case may be, must be kept closed. As no fresh air is allowed to enter from outside, the atmosphere of the room will rapidly become "stuffy", and therefore judgment is needed in opening and closing the external grating.

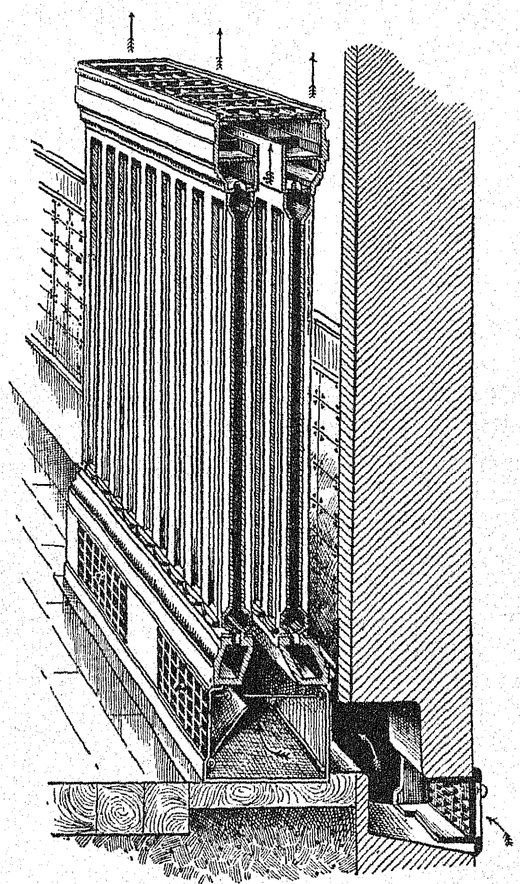


Fig. 531.—Sectional View of Rosser & Russell's Ventilating Radiator.

Such radiator-cases are not considered suitable in all circumstances, but there are other means of arriving at the same end: for instance, fig. 531 represents **a ventilating radiator** quite different from those just described; each separate loop is screwed into the base, and no india-rubber is used in making the joints. In the non-ventilating type the fitting ends with the hollow base into which the pipes are screwed, but in the ventilating type this is fixed upon a special box provided with a large number of small holes in the front of the case near the floor. The usual inlet is provided in the external wall, and protected by a grid. In the base casting a special valve is fixed, consisting of two hinged plates, coupled together by bolts. When this compound valve is pulled forward the holes in the case are closed, and the external air has a free course up between the two rows of tubes, and out through the holes in the top grating; when the valve is pushed in, the external air cannot enter, but the air in the room is free to circulate through the inside of the radiator, as in the case of the radiator previously described. In rare cases cotton cloth or muslin is fitted in the inlet passage, in order to partially clean the air entering the room, but in the great majority of instances this is not done. All arrangements of this kind require attention at regular intervals for cleaning, otherwise they become mere receptacles for dirt, and the air passing into the room may be rendered more impure than the external air.

It is always desirable to have the connections of the pipes to the radiators

made in such a manner as to permit of the **removal of the radiator for cleaning**, as in the last instance it is by no means easy to render the lower box perfectly clean. The dark stain, which will appear above the radiators if they are placed against a wall will clearly prove what a quantity of dust is carried up with the current of heated air.

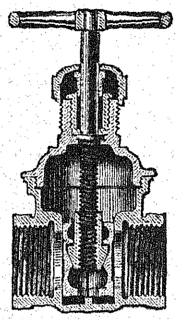


Fig. 532.—Section of Full-way "Peet" Valve.

Stop-valves are very important items in a heating-installation, and it is very poor policy to buy cheap valves, as these are a never-ending source of annoyance. For hot-water work there can be nothing better than a full-way cock, either of the "Peet" type, shown in section in fig. 532, or one of the other types described later. The "Peet" valve consists of two separate disc faces, separated by a wedge-shaped part controlled by a screw. When closed, the two discs shut tightly upon their seatings, and are held there by the pressure of the hand-screw. Such valves are not so suitable for steam, but are well adapted for hot water; the great point which requires attention in a hot-water heating-installation, is that no resistance which can possibly be avoided be offered to the passage of the current.

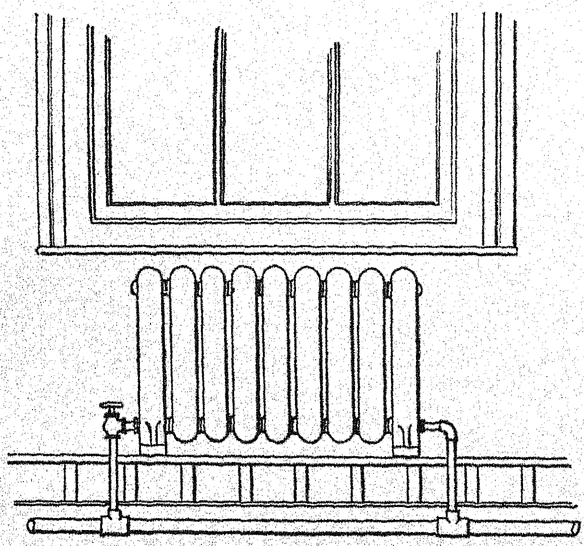


Fig. 533.—Radiator with Elbow Stop-valve.

Another type of stop-valve is shown in fig. 533, and is specially adapted to form an elbow for a radiator connection. These valves should be of gun-metal of good quality, and the plug may consist merely of a conical plug, fitting into a hole turned accurately to receive it; the plug is entirely withdrawn when the valve is fully open, and therefore leaves a full water-way.[1]

Having described in some detail the various pieces of apparatus used in hot-water heating, I shall now consider **the various ways in which the apparatus may be arranged.** The heat, whether obtained from the combustion of coal or coke, gas or oil,

[1] **Safety-valves** are important adjuncts of hot-water apparatus. Numerous explosions, many of which have been attended with loss of life, have occurred in consequence of the omission of these safeguards. The principal cause of explosions is the blocking of the pipes with ice in frosty weather, but stoppage by incrustation may also occur. The simple dead-weight safety-valve is among the best, but as the subject of safety-valves has already been treated in Section IV., pages 275 to 279, nothing further need be said here.—ED.

must be applied to the lowest part of the system, for the simple reason that heated water will naturally be forced upward by colder water. From the usual tables we learn that, when water is heated from 32° to 212° Fahr., it will expand about one-twentieth of its original volume; such an amount of expansion must obviously be allowed for in any form of apparatus, and if this is not done, the containing parts will be liable to burst. In a low-pressure system the pipes must be open to the air at one or more points. Fig. 534 shows the simplest possible system for heating pipes by low-pressure hot water. T represents an open metal tank filled with water, with a pipe connected to it as shown. So long as the tank and pipe are full of water at the same temperature, there is no tendency to circulate, but let a lighted lamp

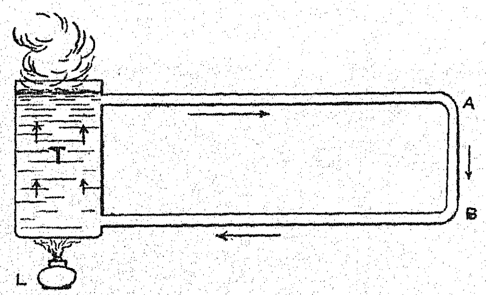


Fig. 534.—Simplest System of Low-pressure Heating.

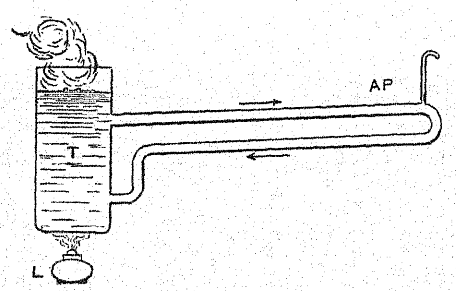


Fig. 535.—Simple Low-pressure Hot-water Apparatus with Air-pipe.

L be applied to the bottom of the tank and heat the water contained therein, then the water in the portion A B will be colder, and therefore heavier, than the corresponding column in the tank, and the action of gravity starts a circulation in the direction shown by the arrows. Now, such an apparatus is obviously too crude to be of practical use. A large amount of heat is lost from the exposed surface of the water, and if the water is lowered by only a slight amount, the upper connection of the pipe will be uncovered and the circulation stopped; but by far the most serious objection is, that it is impossible to carry any part of the pipe above the surface of the water. Air is always present in water, and in such an apparatus bubbles of air might easily collect at A, and impede the circulation. The latter difficulty could be overcome by arranging the pipe as in fig. 535, with a rise to the point A, and there providing an outlet by means of the air-pipe A P.

In the application of the system to practical cases **several points must be carefully observed:—**

(*a*) The heater must be below the lowest part of the circulation-pipes.

(*b*) Means must be provided for the expansion of the water produced by the application of heat.

(*c*) Means must be provided for keeping the apparatus full of water.

(*d*) The circulation-pipes must rise continuously to the highest point and then return gradually to the heater.

(*e*) Means must be provided for ridding the apparatus of air.

Fig. 536 represents diagrammatically **an apparatus for heating two floors** one above the other. The heater is placed in the basement, and of course cannot be left open as those shown in figs. 534 and 535. At a point somewhere above the highest part of the heating-apparatus, will be placed the expansion-tank, which also acts as a feed-cistern for the apparatus; this is marked XT, and is fed with cold water from any convenient source by the pipe CW. The water in this tank never rises more than (say) 4 inches above the bottom of the tank, and actuates a float, which controls the inlet-valve just as an ordinary ball-cock does, but in this case the valve itself is preferably put outside the tank, and the tank covered over and provided with a vapour-pipe VP, which is carried into the open air over the roof. From the top of the heater is carried the rising main, which goes direct to the highest part of the building, and thence round the two floors in the manner indicated. This pipe itself, if of adequate size, would effect the heating of the rooms, but there are several reasons why it is generally inadvisable to use such pipes in houses. In order to obtain the

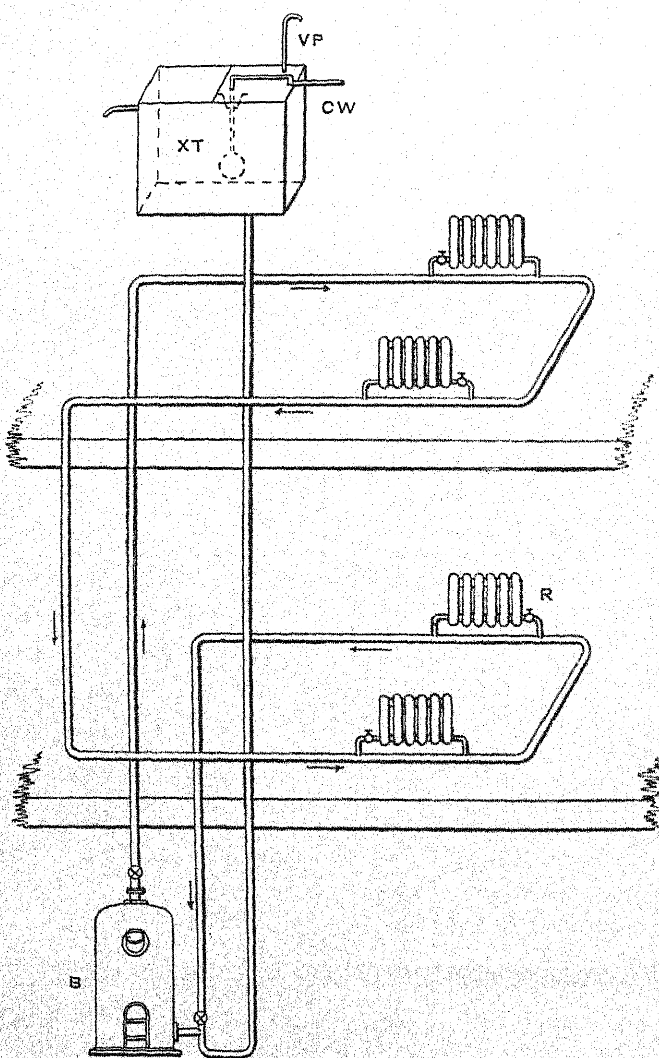


Fig. 536.—Diagrammatic View of Low-pressure Hot-water Apparatus for Heating two Floors with one Circuit.

requisite surface in the length disposable, it would be necessary to use pipe from 3 inches to 4 inches in diameter, and this would seldom be convenient in a private house, as there are doorways to be passed, and a large pipe is very unsightly. A small pipe can be run behind a skirting-board, or under the floor-boards; branches are then taken off to each radiator as shown, and the only parts of the apparatus above the floor are the radiators and their connections. These connections are all taken off the return-pipe, which descends to the heater and is connected to it at or near the bottom; a pipe is carried down from the expansion-tank, and has a U-shaped bend at the bottom, connected to the return-pipe close to the heater. The action of the apparatus will be as follows. With the system full of cold water, the height of the water in the expansion-tank will be (say) 4 inches; as soon as heat is applied, the water will expand up the vertical pipe into the tank XT, and will close the ball-cock, and if it should expand sufficiently, it will pass away by the overflow; hot water will then pass round the system in the direction of the arrows. The valves are marked by an X within a circle. It will be seen that, while the whole of the system can be shut off from the boiler, it is impossible for high pressure to be got up in the boiler, as it is always in open connection with the expansion-tank; the worst that can happen is for boiling water to pass up into the expansion-tank.

This is probably the cheapest scheme which could be devised. The main pipes might be $1\frac{1}{2}$ inches in diameter, and the branches to the separate radiators $\frac{3}{4}$ inch. The heat in each of the radiators can be readily controlled by the valve next to it, but there is no means of emptying a portion of the apparatus so as to allow of the repair of a joint or other similar work. If a second stop-valve were put on the other side of each radiator, this would allow the radiator itself to be removed, but as it would add about 7*s.* 6*d.* to the cost for each extra valve, it is not usually done. Although only two radiators are shown, it is by no means intended that the number should be so limited.

The methods of connecting radiators with the system of pipes deserve mention. It will be observed that, in the last figure, each radiator has a branch off the main, and another back into it, as shown more clearly in fig. 537. In fig. 538, an alternative arrangement is shown with the inlet branch off the flow-pipe and the outlet into the return. If the radiators were arranged so closely together as shown, they might work quite well under the alternative arrangement, but there is always the danger of a short circuit being set up from flow to return, so that while the first radiator would get thoroughly hot, the second might be only warm, and the third almost cold. Such a

thing could not occur with the upper arrangement, and it should always be used except where the branch off the main is so long, and feeds so much radiating surface, that the water is at a very low temperature when it gets back.

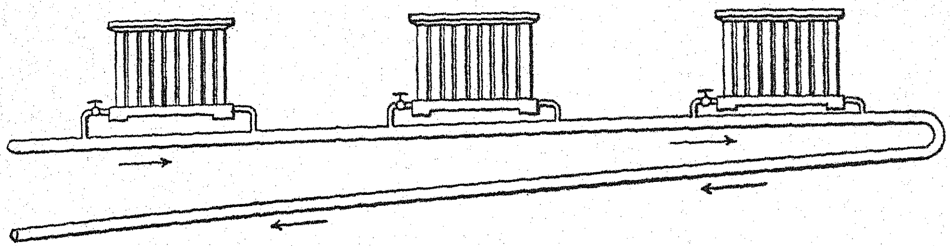


Fig. 537.—Method of connecting Radiators to one Circulation-pipe only.

It is advisable then, and then only, to use the lower arrangement. Radiators connected to a branch circulation-pipe are often on the one-pipe system, as shown in fig. 539. A great saving of pipe can thus be effected, upon what

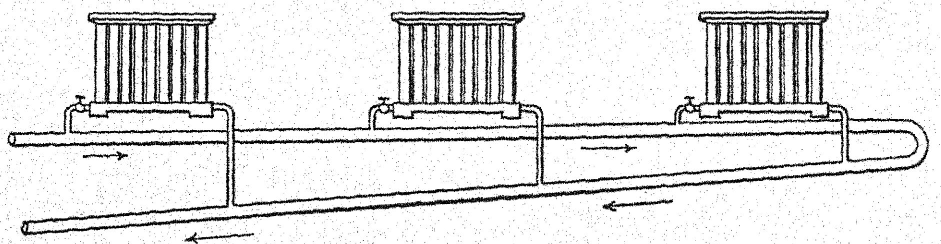


Fig. 538.—Method of connecting Radiators to Flow and Return Pipes.

would be required if both the flow and return pipes were carried along side by side, and the connections made as in fig. 538.

Another arrangement of pipes is illustrated in fig. 540, where each floor is shown to be warmed by a separate circuit. This arrangement is usually adopted in large buildings. Each floor can then readily be shut off, and means can be provided for emptying each of the mains separately at the points C C. It will be necessary to provide air-cocks at the highest point of each of the horizontal runs. It is often somewhat difficult to arrange a method of carrying horizontal pipes on upper floors; doors may be so placed that it is impossible to carry the pipes above the floor, and it may be very difficult to form a suitable channel in the floor itself.

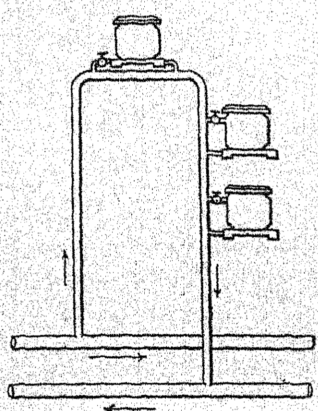


Fig. 539.—Radiators on Branch Circulation-pipe.

For the heating of a ground-floor, **the position of the pipes** may be just below the basement ceiling, as shown in fig. 533. This illustration shows the

main pipe of wrought-iron $1\frac{1}{2}$ inches in diameter, carried in the basement just below the ceiling, and from it are taken off the branch flow and return pipes to the radiator. The radiator should preferably be placed in a window recess, or, if the reveals of the window are not carried down to the floor, it should be placed as close to the wall as possible. An upward current of heated air is then created, which prevents cold draughts from passing direct from the window into the room. Such radiators may be arranged to ventilate the room as well as warm it by direct radiation, if a suitable grating be arranged in the outer wall, and

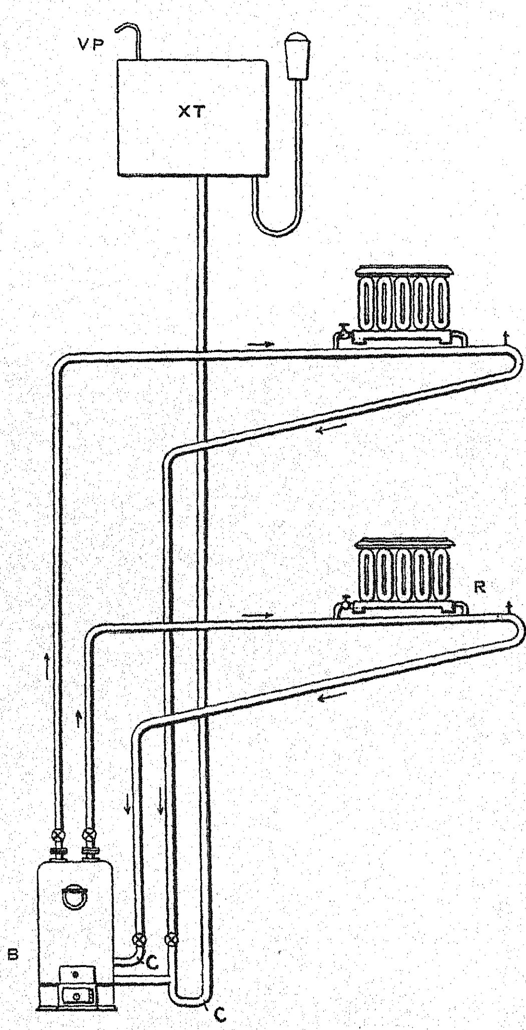


Fig. 540.—Elevation of Low-pressure Hot-water Apparatus, with Separate Circuit for Each Floor.

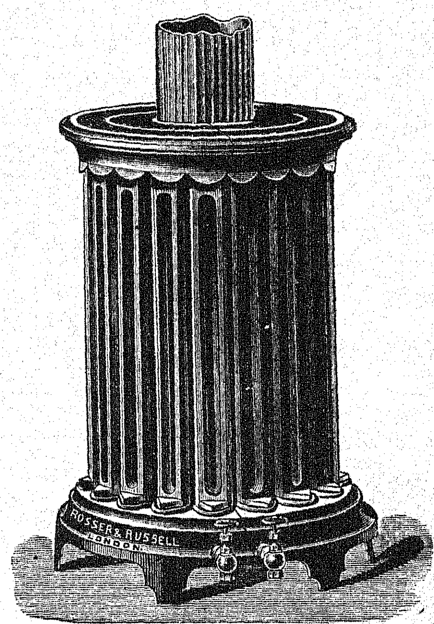


Fig. 541.—View of Circular Radiator for Hall.

suitable baffle-plates inside; details of these have already been given in figs. 530 and 531. For the hall, a radiator of the type illustrated in fig. 541 may be used.

In heating the rooms on the first-floor the same plan cannot be adopted, as of course the main pipe could not be carried through the best rooms on the ground-floor. One plan, therefore, is to prepare a special pipe-channel behind

the skirting-board, as shown in fig. 527, page 124, but even this is not always possible on account of doorways. The pipes, may, however, sometimes be carried between the joists, but should in all such cases be covered to prevent radiation of heat.

Another arrangement of pipes may be adopted, which consists in carrying a main of suitable size entirely around the basement, just below the ceiling, and

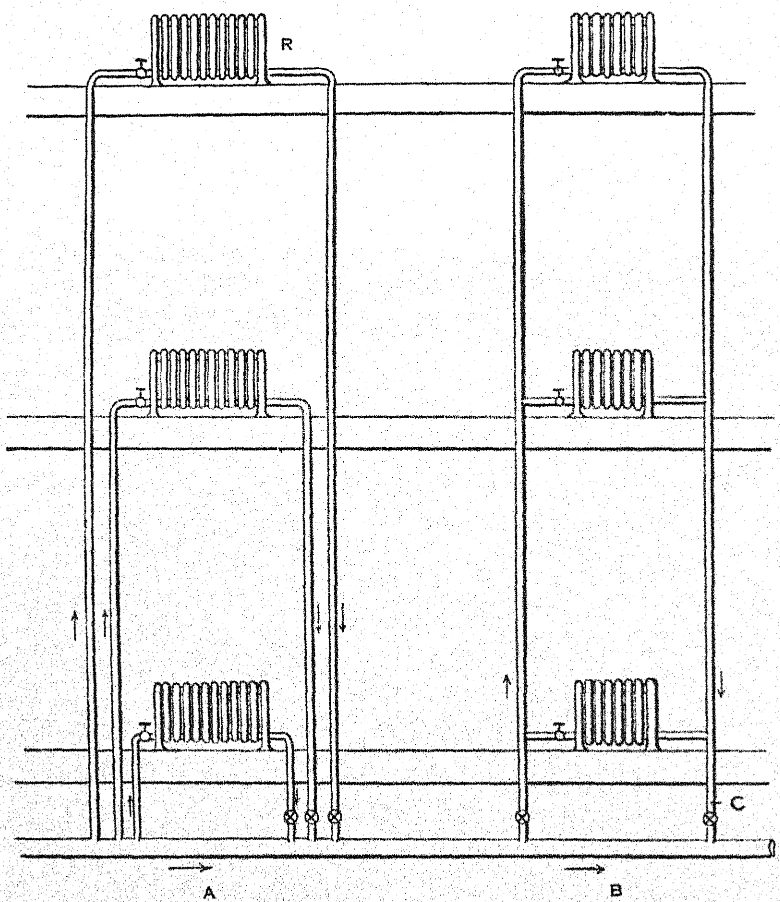


Fig. 542.—Elevation of Pipes for Low-pressure Heating, showing two Arrangements of Vertical Flow and Return Pipes for Radiators.

taking vertical flow and return pipes from this, as shown in fig. 542. In the part lettered A, each radiator has a special flow and return; there is, therefore, nothing whatever to interfere with a good and efficient circulation. The only objection to the system is the number of pipes required. In part B another system is shown, in which there is only one vertical flow and one vertical return; the sizes might be $1\frac{1}{4}$ inches to the first branch, 1 inch thence to the second branch, and $\frac{3}{4}$ inch to the top radiator. It would be well to have a stop-cock close to the main, in both flow and return pipes, and if an outlet be arranged at

C the whole of the loop can be emptied, except the short flow-pipe as far as the first branch. The disadvantage of such an arrangement as that shown, is that the water may flow past the ends of the branches without entering them. There is not the slightest risk about the top radiator, as that is sure to heat well, but there is always a danger that the ground-floor radiator may not get satisfactorily hot. In most of the illustrations, the flow and return pipes are shown to be connected with the same main-pipe, but in some cases, where there is a very long run of branch-pipe before it returns to the main, it is desirable to take the return-pipe back into the return-main, as shown in fig. 539, page 132, as the two last radiators would receive water at too low a temperature to work efficiently, if the long loop were connected up to the flow-pipe only.

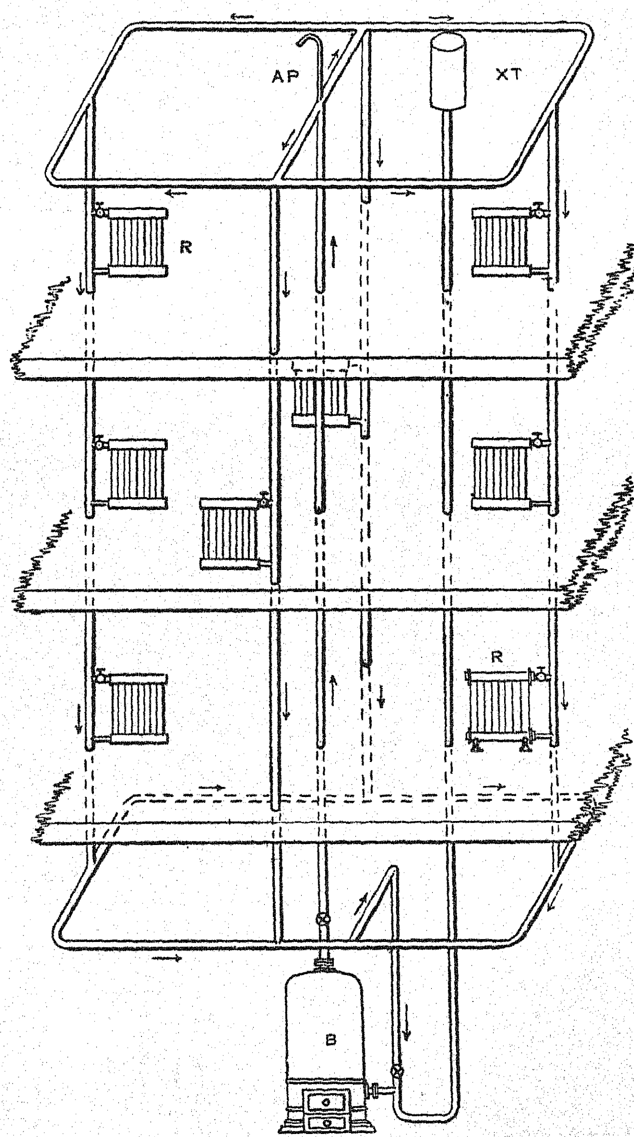


Fig. 543.—Diagrammatic View of the "Mills" System of Piping for Low-pressure Hot-water Apparatus.
B, boiler; R R, radiators; AP, air-pipe; XT, expansion-tank.

Another plan, which has been widely adopted in the United States, and generally referred to as **the "Mills" system of piping**, is to take the flow-pipe direct to the top of the building, and thence to take a number of pipes down as returns to the boiler, as shown in fig. 543. Here the flow-pipe is carried up to the top floor, and feeds a ring-main carried round the building; from this ring descend vertical pipes to a similar ring in the basement, and from the latter ring is taken the return-pipe (or pipes) to the boiler. This gives a very satisfac-

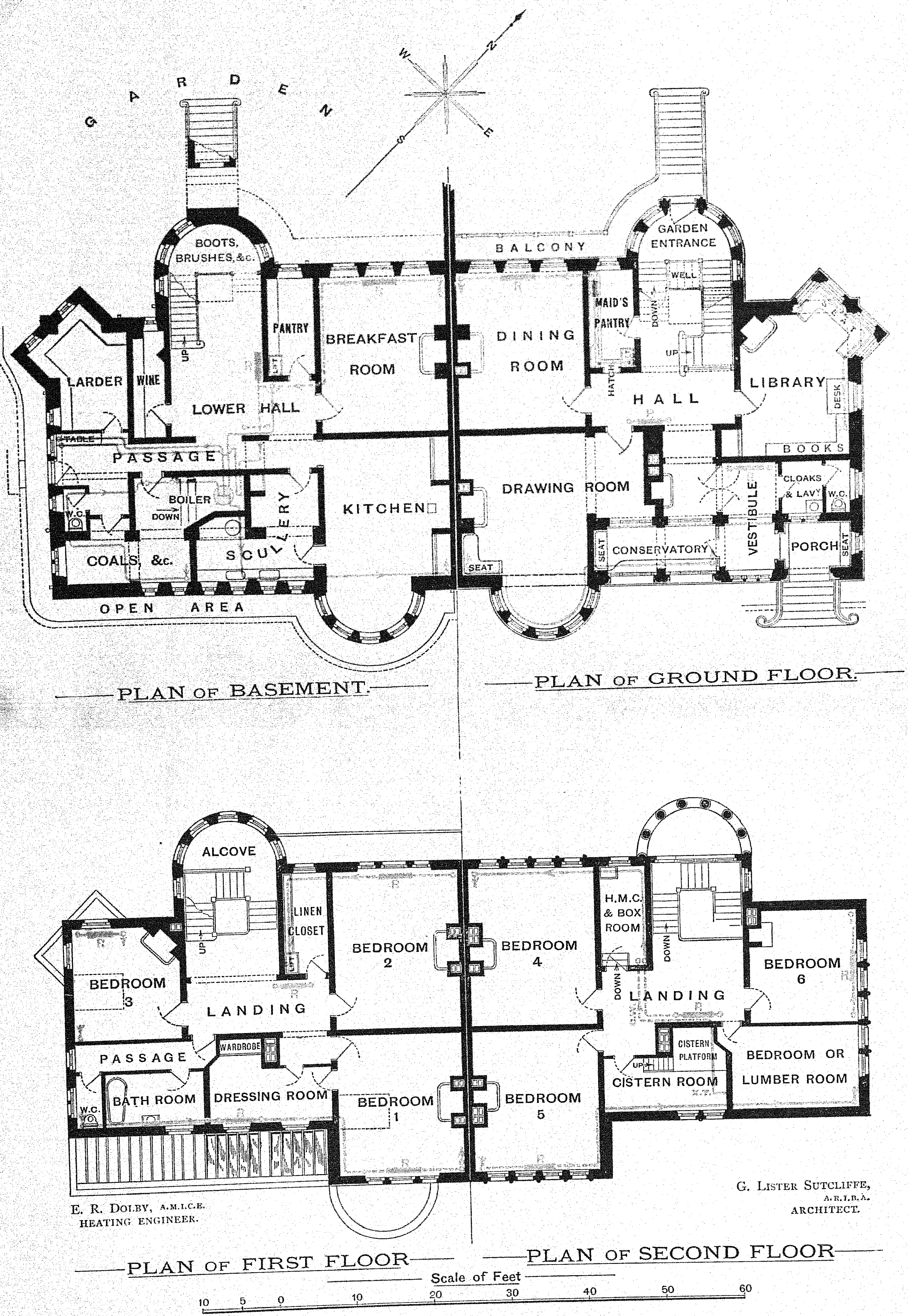
tory result, but if it be considered unwise to depend upon a single flow-pipe, it is easy to take a flow up to the top for each loop. This arrangement is well adapted for use in tall houses of four or five floors; it is, however, open to the objection that the hot water may pass the branches to the radiators without entering them, although it must be said that there is less chance of this in the present case than in that illustrated in fig. 542. When only one flow-pipe is employed, it should have an area approximately equivalent to that of all the return-pipes taken together.

In cases where there are no intervening doorways or fireplaces, **a 3-inch or 4-inch cast-iron pipe** may be arranged, as shown in fig. 520, page 122. This is fed by a small wrought-iron pipe, and for small bedrooms or basement rooms quite sufficient heat will be obtained at much less expense than if radiators are used. In private houses, it is not likely that such an arrangement will be considered suitable, except for servants' rooms.

The low-pressure heating-apparatus for a suburban house is shown in Plates XVIII. and XIX. The vertical type of boiler has been chosen, as it takes up the least room; it is fixed at a level of about 18 inches below the basement floor, in order to allow for the return of certain pipes which are carried below the basement passage. The smoke-flue from the boiler consists of an iron tube carried into any convenient flue which can be used. The boiler itself is provided with a multiple pipe for the flow, and a similar pipe for the return, a "multiple pipe" being merely a pipe provided with several branch-outlets. The expansion-tank marked X T in Plate XIX. is placed in the cistern-room, and fed from the cold-water cistern. A pipe descends direct from this cistern to the boiler to provide a constant feed. There is absolutely no danger of explosion,[1] as the expansion-cistern is open to the atmosphere through a vapour-pipe carried through the roof, as shown in the plate.

Three distinct loops of heating pipes are provided for this house. The flow-pipe of *the first loop* begins at the multiple pipe on the top of the boiler, rises to the ceiling of the boiler-house, passes along close under the ceiling of the scullery and kitchen, and rises in the corner of the kitchen through the ground-floor into the drawing-room; there it rises vertically inside a case, passes through the first floor, and rises vertically through bedroom 1 into bedroom 5; in bedroom 5 it is carried along the floor inside a skirting-case, feeding a radiator at the window, then passes alongside the wall in the cistern-room without any

[1] During the winter of 1896–7, not less than *three* explosions of low-pressure heating boilers occurred, killing one man, injuring another, and doing considerable damage to property, and in every case there was an expansion-cistern open to the atmosphere. The pipes were, however, blocked with ice. The statement in the text is true, so long as the water-way in all the pipes remains open.—ED.



PLANS OF A PAIR OF SUBURBAN HOUSES, SHOWING SYSTEM OF HOT-WATER PIPES FOR HEATING PURPOSES.

The pipes in the basement are nearly all carried along the ceilings. The arrows on the pipes indicate the direction of the flow. R R = Radiators.

casing, and is carried similarly through the lumber-room; thence it descends into the W.C. on the first floor, passes along just above the floor of the bath-room, feeds a radiator in the dressing-room, and is then carried in a skirting-case through bedroom 1, feeding a radiator at the window, descends in a case in the corner of the drawing-room alongside the flow-pipe, and feeds a coil inside a casing carried round the bay-window of the drawing-room, this case being fitted with an open-work front; the pipe then passes along the conservatory, feeding a coil placed below the flower-stands, descends through the ground-floor into the coal-cellar, feeding a radiator in the porch, and passes close to the ceiling through the W.C. into the boiler-house, feeding a radiator in the vestibule, and then passing down is connected to the main return.

The second loop runs as follows:—The flow-pipe begins at the multiple pipe on the top of the boiler, rises to the ceiling, passes across the passage close under the ceiling, across the lower hall, rises through the ground-floor, passes vertically upwards inside the lift in the maid's pantry, and thence into the box-room on the second floor. The radiator on the landing of the second floor is fed from it, and it is then carried along the floor through the box-room, through bedroom 4, descends to bedroom 2, passes along bedroom 2 in a skirting-casing, feeding a radiator at the window, and thence along the floor of the linen-closet, feeding a radiator on the landing; it descends inside the lift to the maid's pantry on the ground-floor, and passes into the dining-room, running in a skirting-case and feeding a radiator at the window; it then descends into the breakfast-room, and is carried round two sides in a skirting-case, feeding a radiator at the window; it is afterwards led across the lower hall and passage in a small channel provided with a cover, and feeds a radiator in the lower hall and also one in the hall on the ground-floor.

The third loop runs as follows:—It rises to the ceiling of the boiler-house, then running below the ceiling of the passage rises into the library, passing up inside a special casing into bedroom 3, thence into bedroom 6, and passes along the side of this bedroom in a skirting-case, feeding a radiator at the window; it descends in the corner into bedroom 3, feeds a radiator at the window, and descends again into the library, there passes round the window, feeding a coil, and runs in a skirting-case along the wall, and finally descends into the basement and back to the boiler beside the flow-pipe.[1]

[1] Every hot-water warming-apparatus must have a draw-off cock fitted to the boiler, or to the return-pipe near it, in such a manner that *all* the water throughout the system can be drawn off. The emptying of the pipes, &c., is a necessary preliminary before certain repairs and alterations can be executed, and during winter ought to be effected *whenever the fire under the boiler is allowed to go out.* Allowing the fire to go out and the pipes to remain full of water is the most prolific cause of boiler-explosions.—ED.

2. *THE HIGH-PRESSURE SYSTEM.*

In my description of the low-pressure system of heating by hot water, it was pointed out that the apparatus was in communication with the open air, so that no pressure, except that due to the height of the water in the apparatus, was possible. If, however, the apparatus be made of sufficient strength, it may be closed entirely, and in that case temperatures may be attained which cannot be reached with the low-pressure system. It is quite usual for a high-pressure system to show **a temperature of 300° to 350° Fahr.** on the pipe-coils, whereas with low-pressure coils a temperature of about 150°–180° is usually not exceeded.

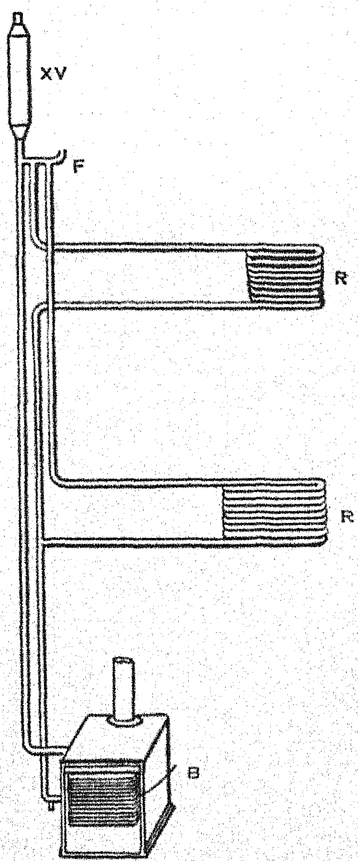


Fig. 545.—View of High-pressure Hot-water Apparatus. B, boiler; F, filling-pipe; XV, expansion-vessel; R R, radiators.

Mr. A. M. Perkins was the inventor of **the high-pressure system** about the year 1837, so that it is by no means a novelty to-day. The system consists in the use of very strong wrought-iron pipes, having an internal diameter of about $\frac{7}{8}$ inch, and an external diameter of $1\frac{5}{16}$ inch. These pipes are joined together in the manner shown in fig. 544; the end of one pipe is tapered both inside and outside to a sharp edge, and the end of the other is left square, and one end is threaded with a right-hand thread and the other with a left-hand thread. The two pipes are connected with a right-and-left-threaded socket, no jointing material of any kind being used; the sharp edge of the one pipe is merely forced against the flat face of the other. The pipe is continuous throughout, and is coiled upon itself to give the proper heating-surface in the furnace.

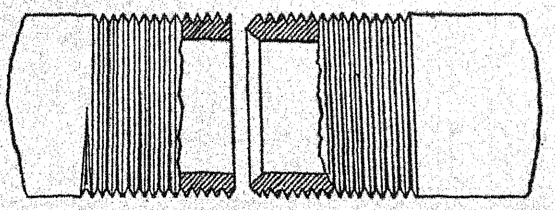
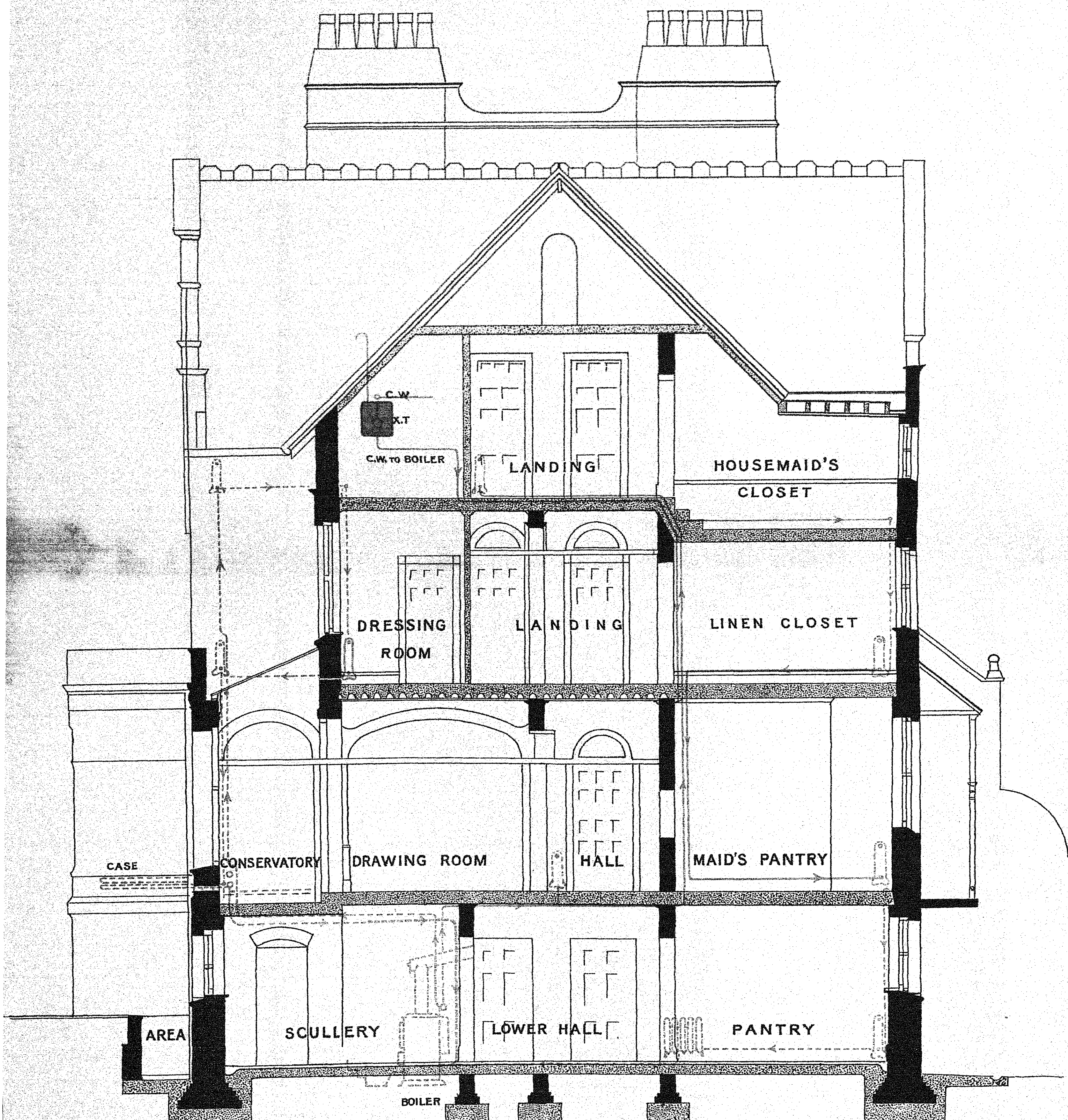


Fig. 544.—Method of Joining Pipes for High-pressure Heating.

The general arrangement of the system is shown in fig. 545. The coil B is placed inside the furnace, and the coils R R are the radiating media; these are

PLATE XIX.



G. LISTER SUTCLIFFE, A.R.I.B.A., ARCHITECT.

E. R. DOLBY, A.M.I.C.E., HEATING ENGINEER.

NOTE.—THE ARROWS ON THE PIPES INDICATE THE DIRECTION OF THE FLOW.

somewhat unsightly, and must be inclosed in ornamental cases if used inside rooms. At the top of the house is fixed a filling-pipe F, which can be sealed off with a proper plug, and above that is an air or expansion-vessel X V, consisting usually of a piece of pipe of rather larger diameter. No air-cocks are required, and no cistern for filling the apparatus. It is merely filled in the first place through the filling-pipe F; the stopper is then fixed, and the apparatus may be started. As soon as the fire in the furnace is lighted, the water begins to expand, and compresses the air contained in the expansion-vessel. A very rapid circulation is set up throughout the apparatus, which will of course continue so long as the fire in the furnace is attended to. The smallness of the pipes renders it possible to put them in places where the large cast-iron pipes of the low-pressure system could not possibly be fixed, and floor-channels of very small size will accommodate quite a large number of pipes. The rapidity of the circulation has also another advantage: it enables the pipes to be carried below the doorways, that is, to dip down in a way quite impossible with the low-pressure system. With the latter, the great objection to a "dip" is that the air will become locked in the higher part of the pipe, but this cannot occur with the high-pressure system, as it is pumped quite full of water and then sealed up; for the same reason no dirt can get in, and no extra water needs to be added to make up for evaporation, as no evaporation can occur. The pipes are often run along the whole length or width of a room at the back of the skirting-board, which is then replaced by a metal grating, allowing the exit of the heated air; or a coil is placed inside a special case with hit-and-miss gratings, and an opening to the external air, as already explained in connection with low-pressure radiators. There is some little difficulty about shutting off a portion of the system, and judgment needs to be exercised.

The pipes, being of such small diameter, are of very small capacity, and the volume of water can, therefore, be readily heated to **a high temperature in a very short time;** this is in many cases a distinct advantage, but in a house it is not of much consequence, as the fire in a domestic apparatus is rarely allowed to go out during the whole of the cold season.

The small volume of water in the pipes renders the system particularly liable to **fluctuations of temperature,** due to the varying condition of the fire in the stove, and this needs somewhat more careful attention than that of an ordinary low-pressure apparatus. Again, if stop-valves are used to shut off part of the apparatus the fire must be regulated to suit, otherwise the proportion of pipe in the stove will become excessive for the length used as a radiating medium, and the exposed pipe will therefore become too hot. The usual proportion of

pipe in the stove to the exposed part, is about as 1 to 10 for ordinary heating work. Of course, in the case of a public hall, where all or none of the heating would be required, the problem is simple, but where, as in the case of a house, the requirements fluctuate, the problem becomes somewhat more complicated. Many private houses, however, are satisfactorily heated by this system.

CHAPTER VI.

LOW-PRESSURE STEAM HEATING.

The system of heating by low-pressure steam is very similar to that of heating by low-pressure hot water, except that, instead of having an apparatus quite full of water and open to the air, so that it is not possible to produce steam above atmospheric pressure, the apparatus is closed and never allowed to get full of water. Steam is generated in a special boiler,—which is placed below the lowest point to be heated,—and then passed into a system of pipes, which are carried into the parts of the building to be warmed, and either themselves give off the heat, or feed apparatus specially designed for that purpose. It is obvious that in the passage of steam through a system of cold pipes a great deal of condensation must take place; the water thus condensed must be carried off as fast as it is formed, and should be used over again in the boiler. For this purpose special pieces of apparatus known as steam-traps are used, which allow free passage to the hot water, but prevent the exit of the steam. All the water passing out has at one time been steam, and is therefore perfectly pure, and if used in the boiler will cause no incrustation; besides this, it holds a large portion of the heat which has originally been in the steam itself.

It may now be advisable to recall to mind **a few facts relating to steam,** including its formation, and the heat which is contained in a given quantity. The British "thermal unit" is defined to be that quantity of heat which will raise one pound of distilled water 1° Fahrenheit in temperature; thus the work of raising one pound of water at 32° F. to 212° F. would be 180 thermal units. But to change one pound of water at 212° F. to one pound of saturated steam at 212° F. and atmospheric pressure, will require 966 thermal units, and the heat required to raise one pound of this steam to a pressure of one pound above the atmosphere will be 0·3 thermal units. The large quantity of heat which is absorbed in the change from the liquid to the gaseous state, is called "latent

heat"; this heat is given back during the change from vapour to the fluid state. When steam, therefore, is used for heating purposes, the heat due to its temperature is made use of, and when it condenses in the pipes it gives off the latent heat, and is taken back into the boiler as hot water.

There is a very considerable **difference between steam and hot-water heating** in the following respect: the quantity of heat contained in the pipes of a hot-water apparatus when full of water is vastly greater than that contained in a steam apparatus when full of steam, although the perceptible temperature of the latter, when tested by a thermometer, may be considerably higher than that of the former. It must be remembered that the capacity of the water for heat is much greater than that of the gaseous steam; the result therefore is that, if steam be shut off, it takes but a short time for the pipes to become quite cold, while, in the case of hot water, the heat is retained for a very considerable time. Heating by hot-water pipes is not subject to such rapid fluctuations as may be the case with steam-pipes. In hot-water systems the pipes must have a good fall back to the boiler, otherwise the circulation will be impeded; the air also must be got out of the pipes. In the case of steam systems it is even more important that the condensation or return pipe should fall towards the boiler, otherwise pockets of water will be formed, which will be blown out suddenly by the steam with loud crackling noises. Air must of course also be got out of the pipes, but in the case of steam at low-pressure the air would be heavier than the steam, and would therefore need to be drawn off at the bottom of the apparatus, and not at the top, as would be the case with a hot-water apparatus.

The principal points which require attention in **the design of a low-pressure steam heating-apparatus** are—firstly, that the whole of the parts are amply strong enough to bear the pressure to which they will be subjected, and secondly, that the pipes are so laid that the water produced by condensation passes away freely under the influence of gravitation.

The boilers used for low-pressure steam-work closely resemble those used for low-pressure hot-water heating, and the latter types of boiler are usually made of sufficient strength to enable them to be used for low-pressure steam-heating. Ordinary cast-iron radiators are often used with steam of 25 or 30 lbs. pressure per square inch, and sometimes, indeed, with steam direct from high-pressure boilers working at 50 lbs. pressure; but I strongly object to putting them to such severe tests, and certainly do not consider that more than 5 lbs., or in exceptional cases 10 lbs. pressure per square inch, should be used in private houses. Throughout the following description, it may be taken that steam of about 5 lbs. pressure is alluded to. Boilers for steam-heating should never be built of cast-

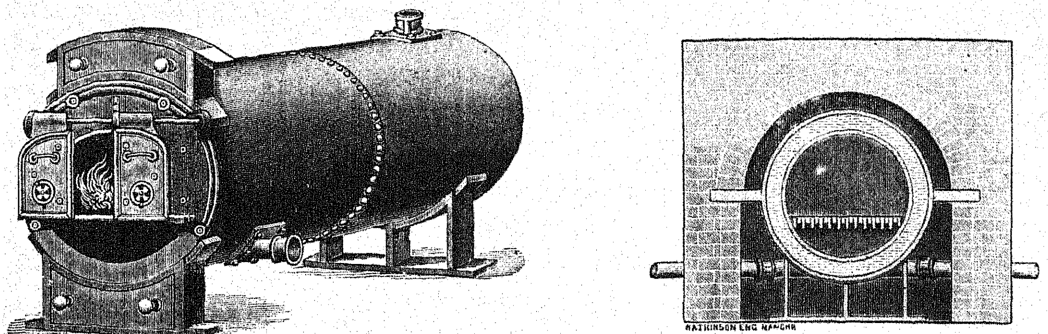
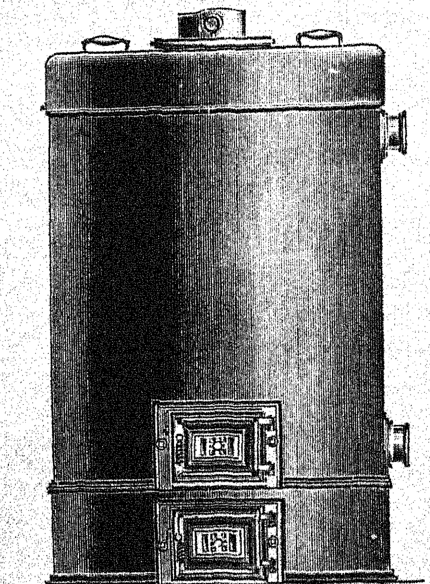
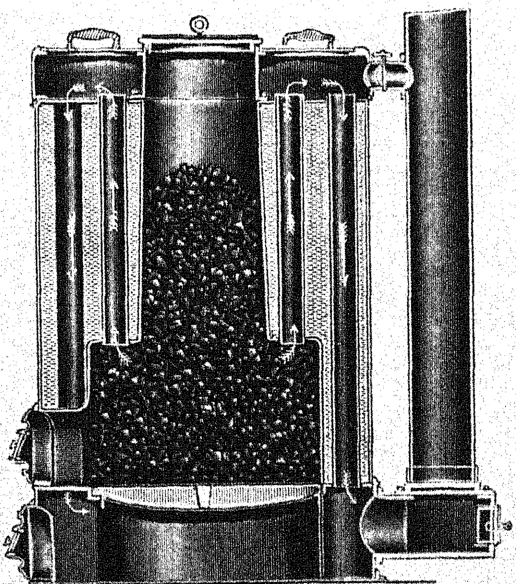


Fig. 546.—View and Cross Section of the "Trentham" Cornish Boiler.

iron. They should have ample steam and water spaces. I consider that no type

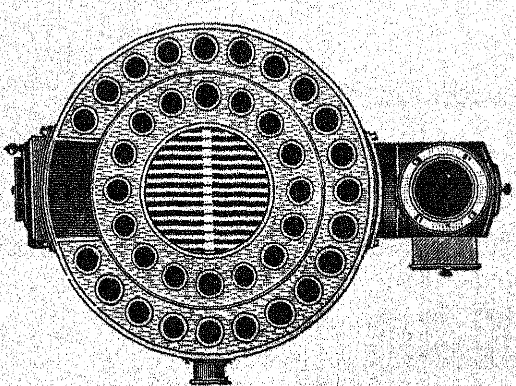


Section.



Elevation.

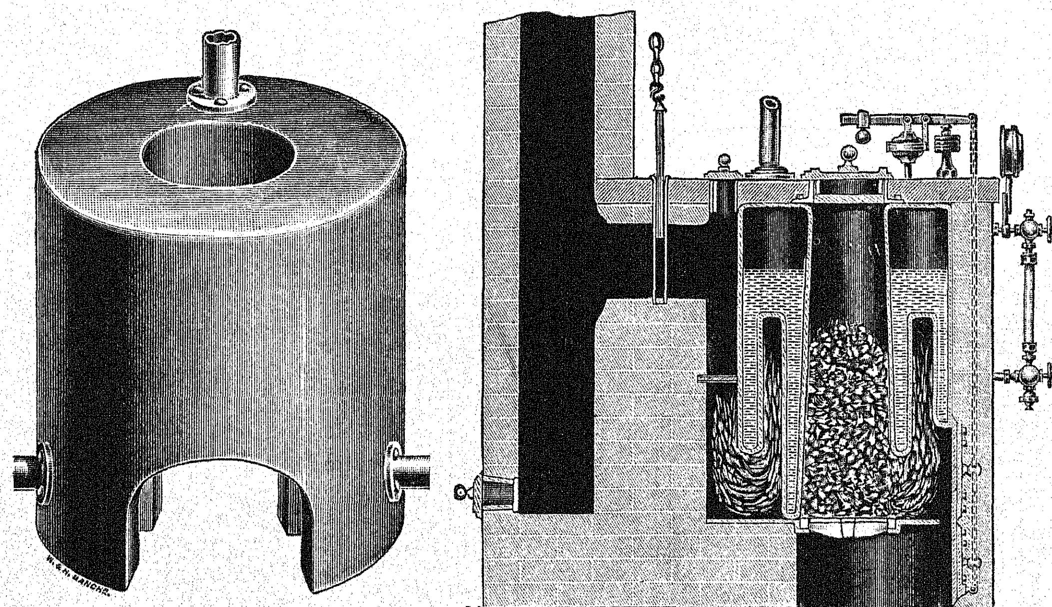
of boiler is so suitable for this work as the ordinary Cornish boiler, that is, a boiler with cylindrical shell and one cylindrical flue, with or without cross tubes, and set in fire-brick with proper side flues. Such a boiler is shown in fig. 546. The grate is inside the furnace-flue, and the products of combustion go from the flue down underneath the boiler, so that the



Plan.

Fig. 547.—Elevation, Section, and Plan of the "Majestic" Independent Boiler for Steam-heating.

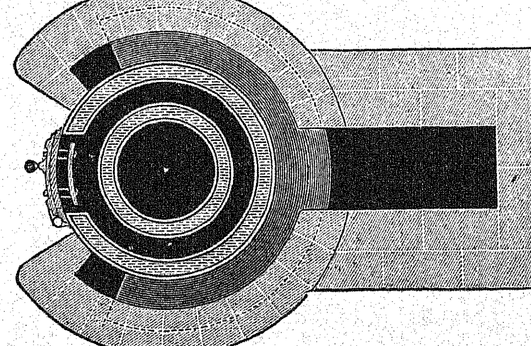
bottom of the boiler receives the hottest gases, and then the draught is split, and the gases pass along the sides and go out into the chimney-stack. Some people, however, prefer to use the saddle type of boiler, with a much deeper crown than in the case of the hot-water boiler, or a waggon boiler, but both these



View. Section.

types are, in my opinion, inferior to the plain Cornish boiler.

In some cases it is very desirable that brickwork should be avoided; **a vertical type of boiler** should then be used, such, for instance, as that shown in fig. 547. This type has the very important advantage that it possesses a central fuel-hopper, so that a considerable charge of coal can be put on at once, and the boiler will not require so much attention. It is arranged with a ring of vertical flue-tubes, through which the products of combustion rise, and also with a second ring of tubes, through which they descend; these tubes are surrounded by the water, so that an



Plan.

Fig. 548.—View, Section, and Plan of the "Caloric" Boiler for Steam-heating.

efficient heating-surface is obtained. A good steam-space is also provided, which is important, as it is very desirable that dry steam should be obtained.

A neat little boiler, which, however, requires brick-setting, is shown in fig. 548. This has also a central hopper for receiving the fuel, and therefore will require less attention than if the door on a level with the grate were the sole means of stoking. The products of combustion pass up into the water-space in an

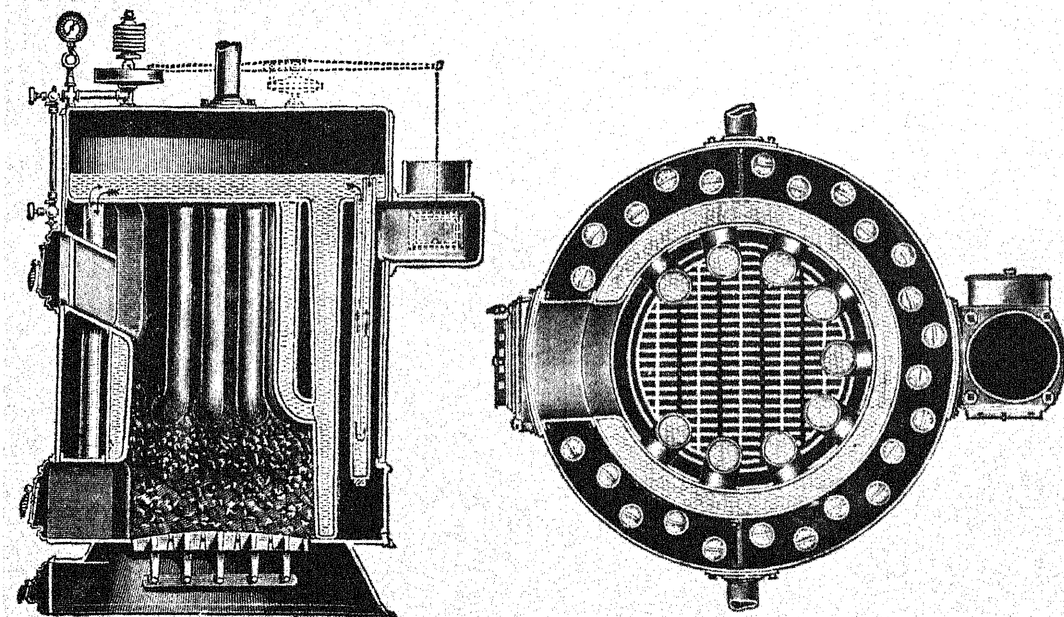


Fig. 549.—Section and Plan of Lumby, Son, and Wood's Patent "Pioneer" Boiler.

annulus before going out to the chimney-stack. One outlet-pipe is provided, and one inlet, although two inlets are shown in the illustrations.

A boiler of somewhat novel construction is shown in figs. 549 and 550, and is known as **the "Pioneer" independent boiler.** As will be gathered from the illustrations, it consists of outer and inner cases, and of a series of water-tubes. It is made in sizes varying in height from 54 to 82 inches; the smallest size is said to be capable of heating 600 square feet of actual radiating surface, and the largest 1750 square feet. These boilers are made of Siemens mild steel plates welded together, and are fitted with safety-valve, water-gauge, and pressure-gauge. It may be remarked in passing that a very similar boiler is made for low-pressure hot-water heating, but in this case the water of course fills the boiler completely.

Every boiler, no matter how small, should be provided with **the following fittings:**—Two safety-valves (one of the lever type, loaded so as to blow off at, say, 5 lbs., and the other a dead-weight safety-valve which cannot be tampered

with, and loaded to, say, 7 lbs. pressure), a reliable pressure-gauge of the Bourdon type, made by some well-known maker, and a water-gauge, so that the level of the water in the boiler may be easily observed. There should be a mark upon the gauge, or a brass pointer should be fixed upon the boiler-casing, showing the proper working-level of the water, so that the attendant may observe instantly if the water is getting too low. If this were to occur the crown of the firebox would become dry, and might become red hot. Fusible plugs are often inserted to guard against such an occurrence, as the fusible metal contained in them melts out, and the water pours in upon the fire and extinguishes it.

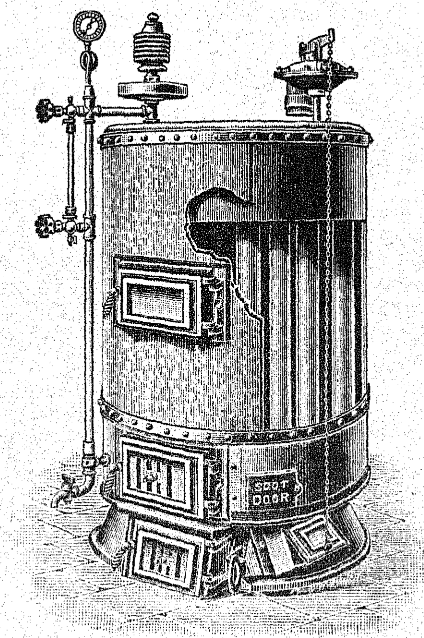


Fig. 550.—View of Lumby, Son, and Wood's Patent "Pioneer" Boiler.

Messrs. Körting Bros. have **a special system of low-pressure steam-heating**, which certainly deserves notice. The boiler itself is represented in figs. 517 and 518, pages 120 and 121. This system differs considerably in many points from the usual methods of heating by steam. Fig. 551 is an illustration of the general arrangement. G is the low-pressure steam-boiler, T the fuel-hopper and patent furnace, *s* the safety-pipe, V V the steam-distribution pipes, S S the coils or radiators to the rooms, *v v* the steam-admission valves, *c c′ c″* the return-pipes for condensed water, A the air-pipe, W the syphon-pipe between the air and water vessels, R the syphon water-vessel with air-pipe, and R′ the syphon air-vessel. The steam-generator, or boiler, which has already been described in detail upon page 121, is placed in the basement of the building, in as central a position as can be conveniently arranged. The steam generated, at a pressure of $1\frac{1}{2}$ to 5 lbs. per square inch, is conveyed by the steam-distribution pipes V V to the radiators S S. The radiators, which are filled with air from which most of the oxygen has been absorbed, are placed upon the various floors, so that they stand as far as possible in series one above the other, and, where this can be arranged, they have joint condensed-water return-pipes *c c*, falling vertically to the basement, where they are collected into a common main return-pipe at the floor-level. A further connection is made from each radiator to the air-collecting pipe A, which is carried under the ceiling of the basement, and connected to the air-vessel R′, and also by means of a "drain-pipe" C, to the main return-pipe

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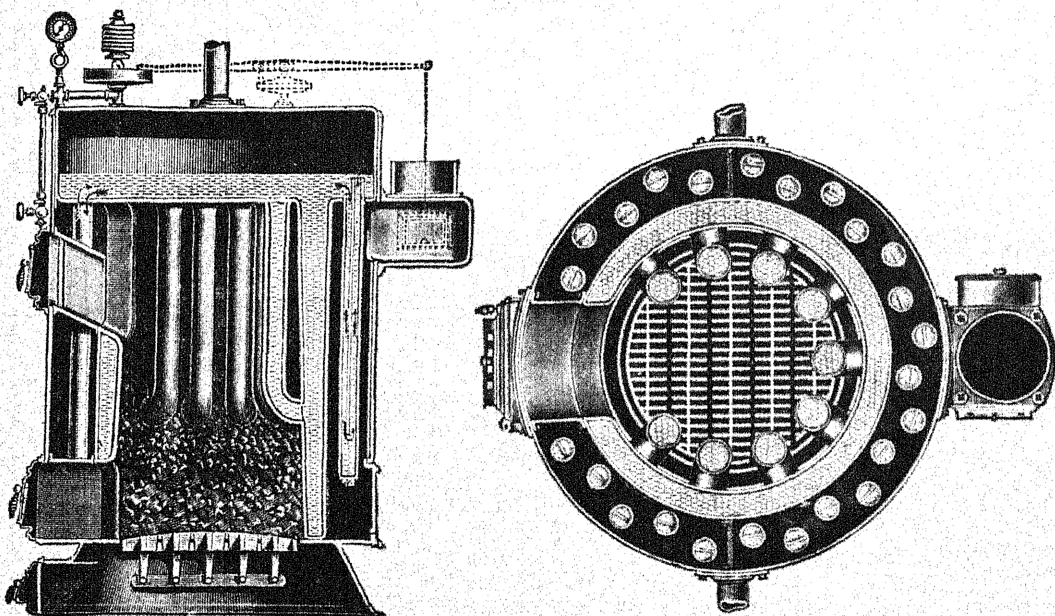

Fig. 549.—Section and Plan of Lumby, Son, and Wood's Patent "Pioneer" Boiler.

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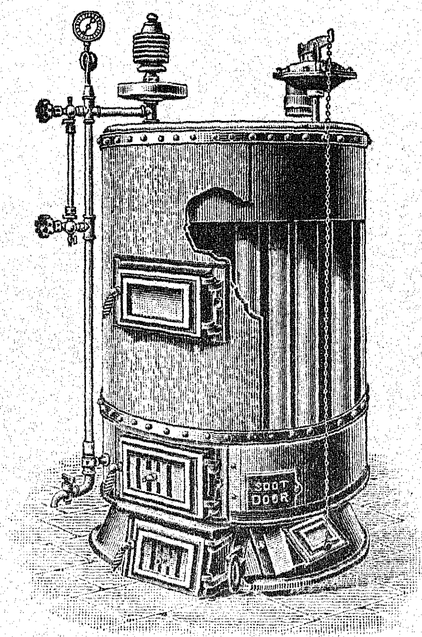

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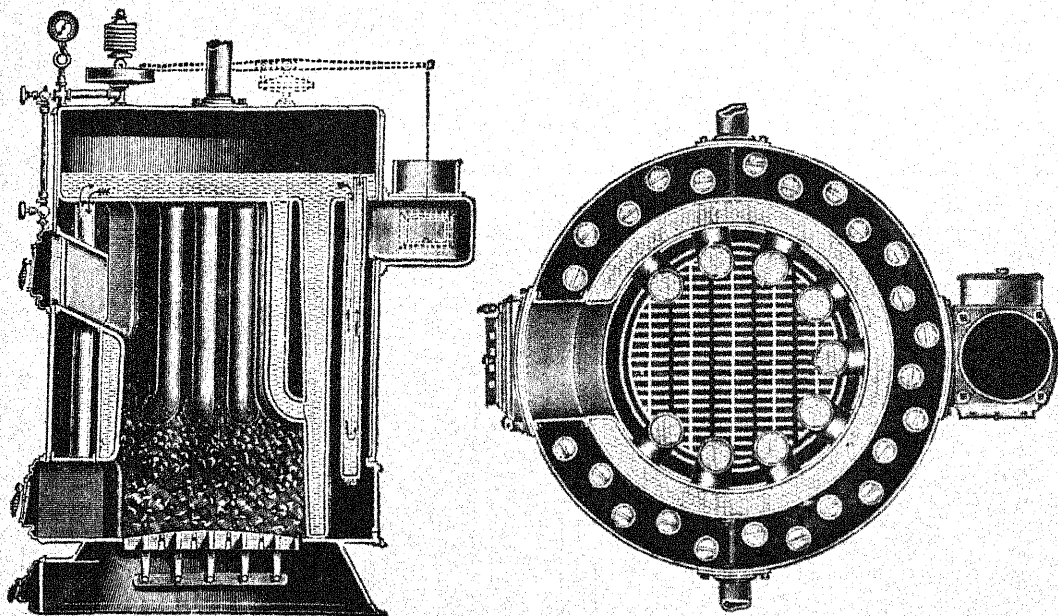

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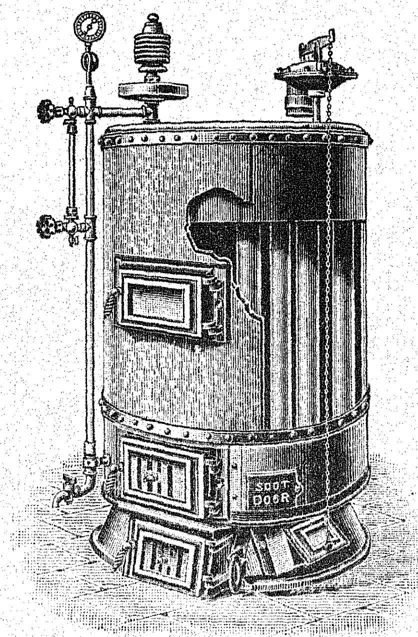

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on the floor. The air-vessel R′ is joined by the syphon-pipe W to the water-vessel R, and as this latter has a pipe open to the atmosphere, it is in consequence always under atmospheric pressure. The capacity of each of the two

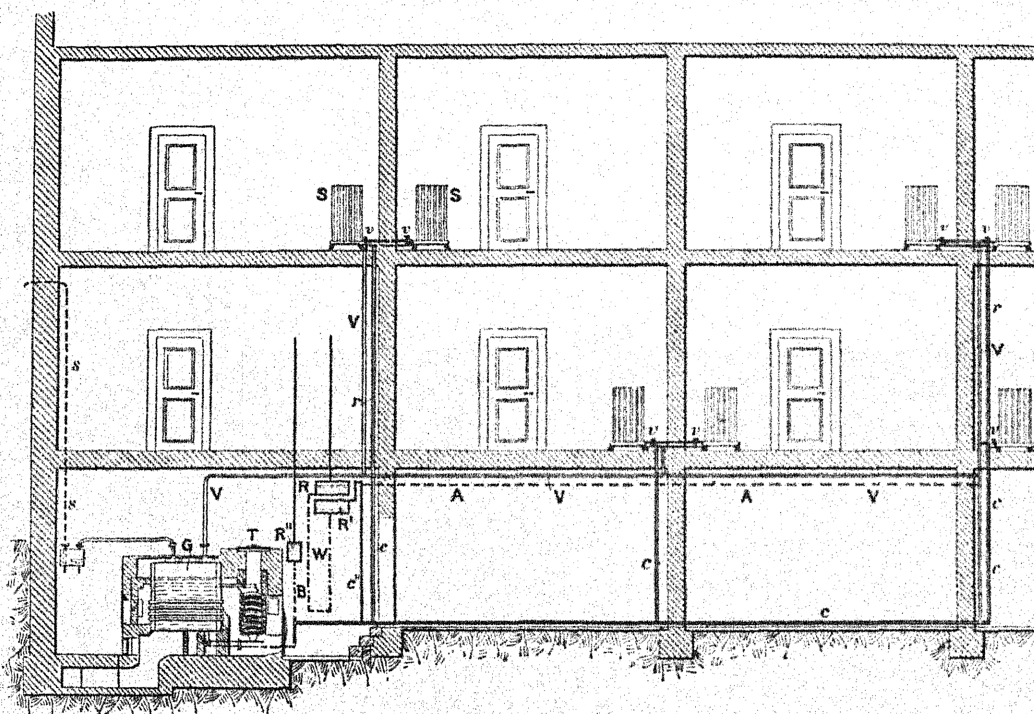


Fig. 551.—General Arrangements of Korting's Low-pressure Steam Apparatus.

A, air-pipe; c c′ c″, return-pipes for condensed water; G, low-pressure steam-boiler; R, syphon water-vessel with air-pipe; R′, syphon air-vessel; s, safety-pipe; S, coils or radiators in the rooms; T, fuel-hopper and patent furnace; v, steam-admission valves; V, steam-distribution pipes; W, syphon-pipe between air and water vessels.

vessels, R and R′, is equal to the total cubic contents of the radiators, the steam connections, and the steam-space of the boiler.

The working of the apparatus is quite simple. The boiler G, and the syphon air-vessel R′, are filled with water to the required level, and as soon as steam is generated in the boiler, the air, occupying the steam-space of the boiler and distribution-pipes V V, is displaced by the steam and driven through the radiators into the vessel R′, displacing in turn the corresponding volume of water from this vessel, and driving it into the vessel R through the syphon-pipe W. Each radiator has a specially-constructed steam-valve, as shown in fig. 552. The valve has an indicator, and by reference to this the degree to which the valve is opened may be ascertained, and accordingly as the valve is more or less opened, more or less air will be forced out of the radiator into the vessel R′. If the regulating-valve be quite closed, the steam in the radiator will quickly condense, and the radiator will again fill with air from the vessel R′.

The advantages of this system are considerable. The air in the heating-system cannot escape, as it is trapped on the one side by the water in the boiler, and on the other by the water in the vessel R, and therefore no fresh air from outside is taken into the system. This fact is of the greatest importance, as the air, hermetically inclosed in the system, loses its oxygen in a very short time, and ceases to have the slightest corrosive action upon the inside of the pipes and radiators. Air-valves are not required, and the regulation of each radiator can be effected perfectly and easily by one steam-valve. The heating may be carried on either continuously or with breaks, as may best suit the character of the building, the season of the year, or the preference of the owner. As all the connections which contain water when the heating is out of use are without exception in the basement of the building, the risk of freezing is very slight indeed, and damage to the radiators and pipe-connections above the basement from this cause is quite impossible. The water-level in the boiler is not subject to any variation during working, as all the condensed water is returned direct by gravitation, and perfect noiselessness of working is secured, if the steam and water never come into direct contact with one another in the pipes.

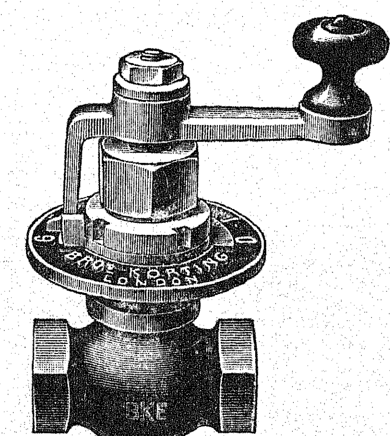


Fig. 552.—View of Steam-valve.

The maintenance of a constant pressure is of special importance in low-pressure steam-heating, and the inventors of this system have designed **an automatic draught-regulator** (shown in fig. 520, page 122), by which this is secured. Q Q_1 are vessels containing mercury, D is the steam connection to the boiler, W the water-connection to the stand-pipe, S a float, H the lever arm, F a movable weight, and V V_1 valves for regulating the admission of the air. The action of the regulator depends upon the change of level of the surface of the mercury in the vessel Q. The upper part of this vessel is connected by the pipe D to the boiler, and the mercury rises and falls as the variation of the steam-pressure in the boiler causes the movement of the float S, which works the lever H, on the ends of which the double valves V and V_1 are suspended. When the pressure in the boiler rises to a certain height, the valve V_1, which regulates the air-admission to the furnace, commences to close, and the valve V, which allows air to pass by a second canal in the boiler-setting direct into the flue, begins to open. When the maximum pressure desired is reached, the valve V_1 is completely closed and the valve V fully opened, so that the fire is deadened and

does not again burn briskly, until the reduction in steam-pressure has resulted in the sinking of the float S, and the consequent alteration of the position of the valves V and V_1.

An improvement has been made in the regulator by the introduction of the movable weight F. By altering the position of this weight, the valve V and the float can be nearly balanced, and it is possible to obtain a constant pressure of from $4\frac{1}{2}$ lbs. down to 0·15 lbs. per square inch. It is thus possible during the night, or at intervals when the heating is not required, to lower the pressure, thus causing the coils in the various rooms to be partly filled with air, and thereby reducing the fuel-consumption during this time to a minimum. When heating is again required, the weight is moved, and the steam-pressure rises; the air is forced out of the coils, and the rooms are warmed without anyone in the rooms troubling in the least about it. The heating of all the rooms is in this way under full control from the boiler-house.

Although, in ordinary working, **an excessive rise in the steam-pressure** is prevented by the draught-regulator, it is conceivable that, by some accident, such an increase may occur. The steam-pressure would then force the water out of the syphon in the stand-pipe; the steam would escape, and the pressure would altogether disappear. In such a case the pressure on the mercury in the regulator would also cease, and owing to the consequent sinking of the float, the air, which had been kept from the furnace by the closed valve V_1, would be admitted again, and there would be risk of burning out the boiler. The regulator is, however, so designed that all such risk is prevented. There is a second vessel Q_1 containing mercury, connected by a small pipe W to the upper part of the stand-pipe. Should the water blow out of the syphon, part of it flows out of the stand-pipe into Q_1, which is thus under water-pressure equal to the height of the stand-pipe. As this pressure is at least as high as the maximum steam-pressure needed to work the float, this will maintain the float in the position in which air is cut off from the furnace, until the water in the pipe W is allowed to run out through the valve E, fig. 519, page 122.

I have entered at some length into a description of Messrs. Körting Bros'. special system, because I consider that their **method of dealing with the air and condensed water** is extremely ingenious. In examining steam-heating plants, one observes constantly that the air-cocks are placed at the top of the radiator coils, either through carelessness, or because the designers do not realize that air is heavier than steam; the result is that air-cocks are opened, and steam is seen escaping, and they are at once shut upon the assumption that no air is present in the coil. The heating is not found very satisfactory, the reason being that

there is always a stagnant body of air at the lower part of each radiator, and this is very difficult to heat to the temperature of the steam. Quite elaborate arrangements of pumps are also provided in order to get the condensed water back into the boiler, although, as already pointed out in describing this system, the whole of this work can be done by gravitation if the scheme is only properly designed.

Messrs. Körting Bros. also state that, for their low-pressure steam-heating, they use as far as possible **radiators** which, according to their latest invention, are not filled with steam alone, but with a mixture of air and steam. Formerly when the steam was admitted to the top of the radiator, it pushed the air partially or entirely out, but steam being lighter than air, the result was that, when not worked to their full capacity, the top of the radiator was actually heated to the full temperature of the steam, while the bottom being full of air, remained cool. Now the steam is admitted by a special arrangement to the bottom, and the steam and air rise and circulate through the radiator, warming the whole of the surface to a lower or higher temperature according to the temporary requirements. The inventors of the system claim that the radiators, although warmed by steam, give the same agreeable heat as low-pressure warm-water coils, without having the disadvantages of that system, and especially without the disadvantages of freezing in winter. Of course the steam-pipes are relatively smaller than hot-water pipes calculated to do the same work, and therefore cost less.

In the chapter on low-pressure hot-water heating, I have described a number of forms of radiators, most of which are equally suitable for steam; the only point to be borne in mind is the position of the air-cocks. The inlet and outlet pipes for steam will also be smaller, and if stock-pattern radiators are bought, it will be necessary to use a nipple to reduce the size of the opening. Messrs. Körting Bros. make a type of radiator with specially thin gills, which is very cheap, and also gives a very large surface for the radiation of heat. Two varieties are shown in fig. 553, the square and the oval. These are solidly constructed, but are not of sufficiently artistic appearance to be used in living-rooms without some kind of ornamental case, which may be either of cast iron or wrought.

The inventors of the system, which has here been fully described, lay down **the following principal requirements,** which should be fulfilled by a low-pressure steam-heating apparatus, and claim that their apparatus fulfils them:—

(1) There must be complete control of the temperature of the rooms heated.

(2) The coils or radiators ought to be below 212° Fahr., as at higher tem-

peratures the small particles of organic matter, which float in the air in the form of dust, are volatilized when coming into contact with the heating-surface, and disagreeable and unhealthy smells result.

(3) The steam-generator must be constructed so as to secure continuous and

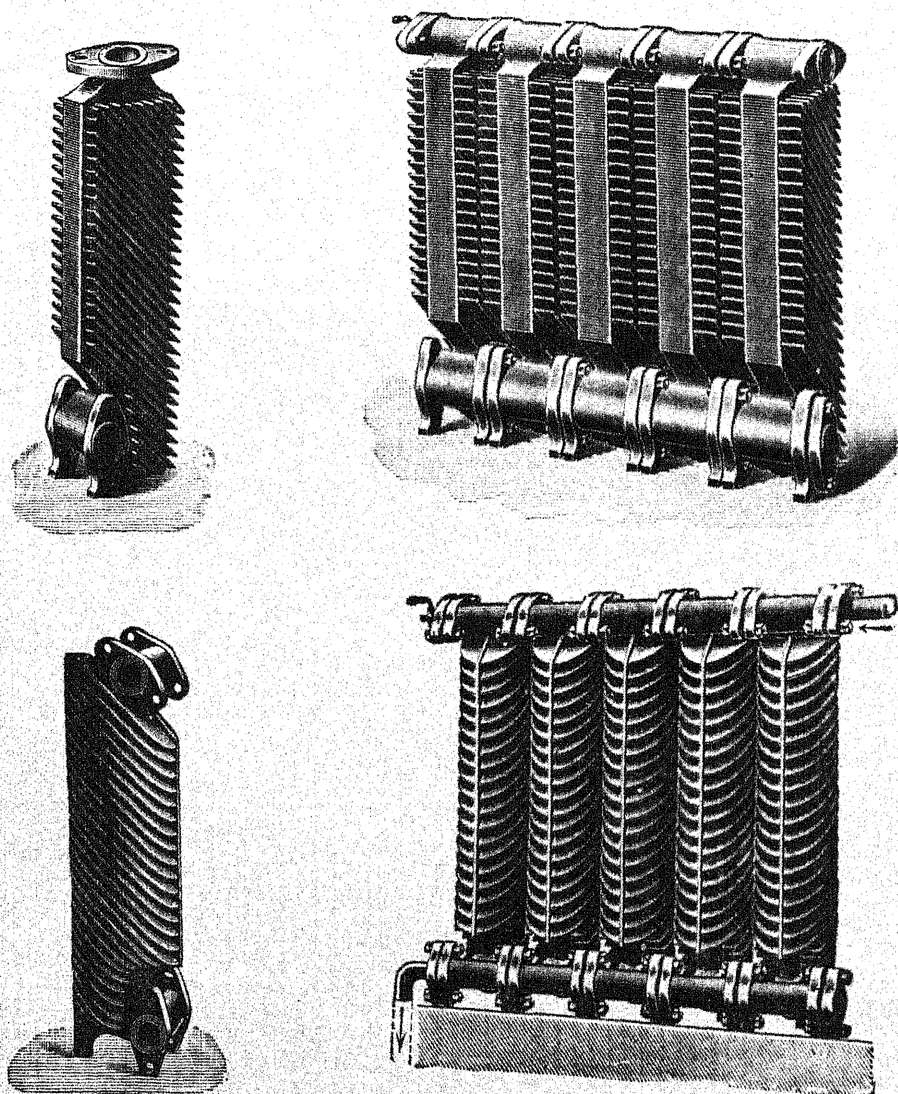


Fig. 553.—Views of Körting's Radiator, Square and Oval Patterns.

efficient combustion of the fuel, to avoid the inconveniencing of the neighbourhood by the emission of smoke, and to prevent any formation of clinker in the furnace. Further, there should be no liability of damage to the generator owing to possible neglect.

(4) The consumption of fuel must be automatically regulated to suit the

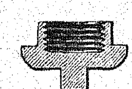
variation in the demands on the heating-surface in the rooms, so that the actual weight of fuel burned in the furnace in a given time is proportionate to the amount of heat passing into the rooms from the heating-surface.

(5) To minimize the attendance, the steam-boiler must have a furnace-hopper of such capacity as to contain fuel sufficient at least for the night, so as to dispense with night attendance, and also to secure that the fuel only needs replenishing at lengthy intervals during the day.

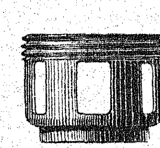
(6) Any portion of the heating-system, which may be liable to exposure to frost, must be quite free from water, when the heating is not in operation.

(7) There must be no liability to rusting, either on the inside or the outside of any part of the heating-system.

Lap-welded wrought-iron pipes, of what is known as "steam quality", should be used, with wrought-iron elbows, tees, bends, &c., throughout. Cast-iron pipes are not suitable for use with steam. The supports for the pipes will be of a smaller and simpler kind than those needed for hot-water work, and generally the whole of the pipes will be of smaller size and will be found much easier to run in confined places; these small pipes can readily be taken behind skirting-boards and in other similar positions, where it might be difficult or impossible to fix hot-water pipes.



Loose valve attached to end of spindle by a nut.



Seating screwed into valve body.

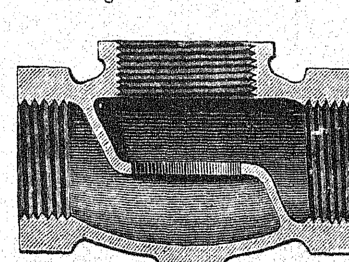


Fig. 554.—Dewrance's Renewable Valve.

The stop-valves used in this work will require to be of a different type. In preference to the "Peet" valve, I use such a valve as that made by Messrs. Dewrance of London with a renewable seating, and illustrated in fig. 554; these cocks have a good seating, and will last a very long time. For the smaller sizes, say up to 2 inches, they are made of solid gun-metal, and in a house it is scarcely likely that valves larger than these will be required. For the condensed-water pipes, a valve such as the Peet valve may certainly be used, as it affords a full way, which is of some advantage. The whole object in hot-water work, in fact in water work of any kind, is to afford as full an opening as possible, and to change the direction of flow as little as possible, as change in direction means added friction. For steam, however, a slight change in direction makes no difference, but it is essential to obtain a good seating for the valves. In a low-pressure steam-heating plant, there will be less energy

expended in friction in the pipes themselves than in a hot-water apparatus, as in the latter case the medium is a fluid and in the former a gas.

CHAPTER VII

COMBINED STEAM AND HOT-WATER APPARATUS AND GENERAL CONCLUSIONS

In the arrangements described hitherto **the position of the boiler** has always been at the lowest point, but it is sometimes inconvenient to place it in that position, and excavation may be needed, which often entails difficulties with ground-water. In recent years several methods have been adopted which enable this difficulty to be surmounted, and many installations may now be found where the boiler is placed above some of the radiators. One of the systems is known as the "**Reck**" and was the invention of a Danish engineer, and another is Barker's "**Cable**" system; both these systems are worked by Messrs. G. N. Haden & Sons of Trowbridge, who are the sole licensees for the United Kingdom.

Other firms carry out similar arrangements, and we have examined an installation put into a London warehouse by **Messrs. Werner, Pfleiderer, & Perkins,** where the boiler was fixed upon the third floor, and the whole of the floors were heated, including the basement. Fig. 554A will give a general idea of this firm's method, arranged for the heating of a private house. A is a hot-water boiler, which has the usual outlet-pipe at the top and return at the bottom. Inside the firing chamber of the boiler is a pipe-coil B, in which steam is generated; the steam passes to the displacer C, and presses water therefrom through the non-return valve E into the bottom of the water-heater A. A similar quantity of water is thus also pressed from the top of the heater through the flow-pipe S, and around the circulating mains into the expansion-tank J; during this operation the non-return valve F is closed. When water has been displaced in the vessel C to the required level, steam enters the condenser D, and a vacuum is produced which closes the non-return valve E, opens the non-return valve F, and sucks water from the expansion-tank J through the return-pipe H and the condenser D, until the displacer C is again filled. This cycle of operations is repeated continuously and automatically.

The heater A may be placed in any desired position, not necessarily at the lowest part of the apparatus; in fact it may be placed at any level below the

expansion-tank, so that expensive excavation for the formation of a boiler-chamber below ground may be avoided.

It will be seen from the diagram that the pipes may be run up and down

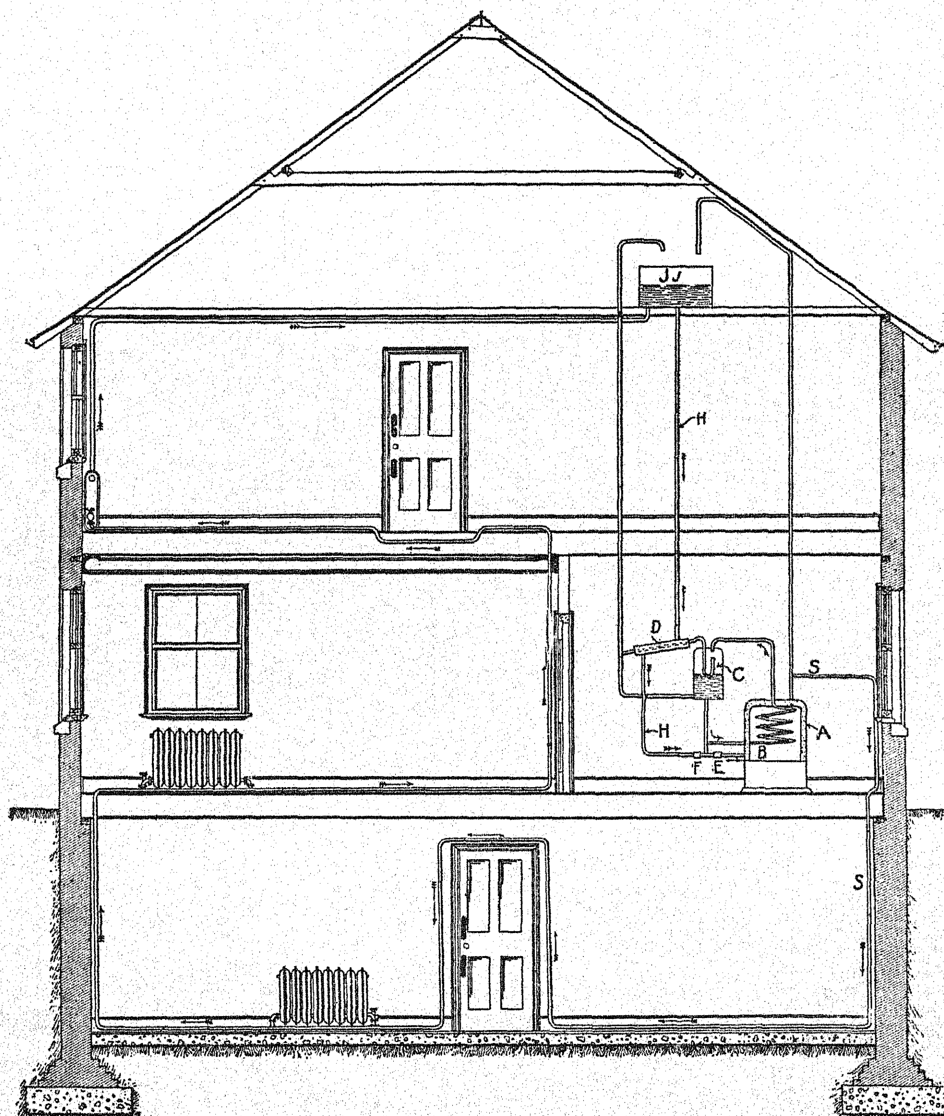


Fig. 554 A.—Messrs. Werner, Pfleiderer, & Perkins's System of Forced Circulation.

without regard to levels, and the pipes themselves may be of smaller diameter than in the ordinary gravity circulation system.

General Conclusions.—I consider **the system of open fires** of coal or wood to be by far the most healthy of all the systems which have now been described;

and, with due attention to the methods by which the consumption of fuel can be diminished, while greater efficiency in the use of the fuel is obtained, I do not see that it can well be improved upon for private houses in the British Isles. It is, however, desirable that a special supply of air should be brought to the fire from outside wherever possible.

Where it is desired to use **some auxiliary system,** then I consider that low-pressure hot-water is, taking it all round, the most suitable for general use, as being perfectly safe and requiring little attention. I do not consider systems of heating by heated air desirable, if they are to be used instead of fires, but as auxiliary means of providing general warmth, they may be of service; the chief objection in my mind to the use of heated air is, that it is necessary to breathe the heating medium, whereas the ideal to be aimed at is to heat the objects, the walls, and the persons in the rooms, while leaving the air comparatively cool for breathing. Systems of steam-heating and high-pressure hot-water heating have their uses as auxiliary means of heating, and are specially to be recommended where it is desirable to occupy as little space as possible with the pipes.

Close stoves and close fireplaces are, in my opinion, not to be recommended in preference to open fires, except upon the basis of lower financial cost of maintenance. The cold of the British winter is not usually so severe as to call for such means of heating, and although perfect smokelessness can be obtained by the use of some of these apparatus, yet the smoke can so far be diminished by the use of suitable open grates that they cease to be very objectionable in this respect.

Gas-fires are not, in the author's opinion, desirable, as there is usually a smell produced by them; if the register is not very carefully adjusted, either most of the heat disappears up the chimney, or, on the other hand, invisible products of combustion, in the form of carbonic acid gas, &c., are discharged into the apartment.

In closing, I would say again that it is desirable to warm the whole of the house and not a mere part of it, and to prevent draughts by arranging for special inlets and special outlets of the air, and this can be done perfectly in the case of new buildings, although probably with only partial success in the case of buildings already completed.

SECTION X.

WARMING AND COOKING BY ELECTRICITY

BY

E. A. CLAREMONT

MEMBER OF THE INSTITUTE OF ELECTRICAL ENGINEERS; MEMBER OF THE INSTITUTION OF MECHANICAL ENGINEERS; AUTHOR OF "ELECTRIC LIGHTING", ETC.

SECTION X.—WARMING AND COOKING BY ELECTRICITY.

Before entering upon a discussion of the merits and demerits of the utilization of electricity as a means of producing heat, either for cooking or warming, it would be well to consider the causes which have led to its adoption. Let us then, for a moment, consider **the means usually employed for cooking** in the kitchen of an ordinary home, *i.e.* the use of coal in an open range. The efficiency of such a method in the case (say) of roasting before the fire, is usually considered to be as low as from 10 to 15 per cent of the heat produced, and when we consider that the remaining percentage is either actually lost by going up the chimney, or is spent in making it generally uncomfortable for the cook, we feel that we have hardly got value for our fuel. Some slight improvement has been obtained by enclosing coal-fires in stoves. But even they, although not allowing the heat of the room to become excessive, still permit an enormous waste in the shape of hot air going up the chimney.

Another method of cooking very much in vogue consists in the use of gas-stoves. Careful experiments, however, have shown that, although obtaining a much higher efficiency than coal, with the additional advantage of no surrounding heat, about four-fifths of the total heat generated is, in the case of roasting, uselessly dispersed. In addition to this, food cooked over gas frequently has a disagreeable flavour, while the stove, even if it has ventilators attached, almost invariably gives off a quantity of noxious gases,—sometimes that known as "acetylene",—which are the direct cause of the headache, which usually comes on after entering a room in which a gas-stove has been burning.

A good cooking-apparatus should, in addition to being of moderate cost while actually in use, possess the following advantages:—1. No smell; 2. No external or radiant heat; 3. No generation of noxious vapours; 4. The quality of being able to be turned off or quenched, either partially or wholly, as cooking

medium, but giving only one intervening plate to be heated, instead of at least the two used in the case last mentioned.

On coming into **a kitchen where an electric oven is in use** (see fig. 555), we are at once struck with the great difference between its surroundings and those pertaining to the old-fashioned range. Among the things which have disappeared are the smell of smoke, the risk of falling soot, and the high surrounding temperature due to keeping up a large fire for an hour or two

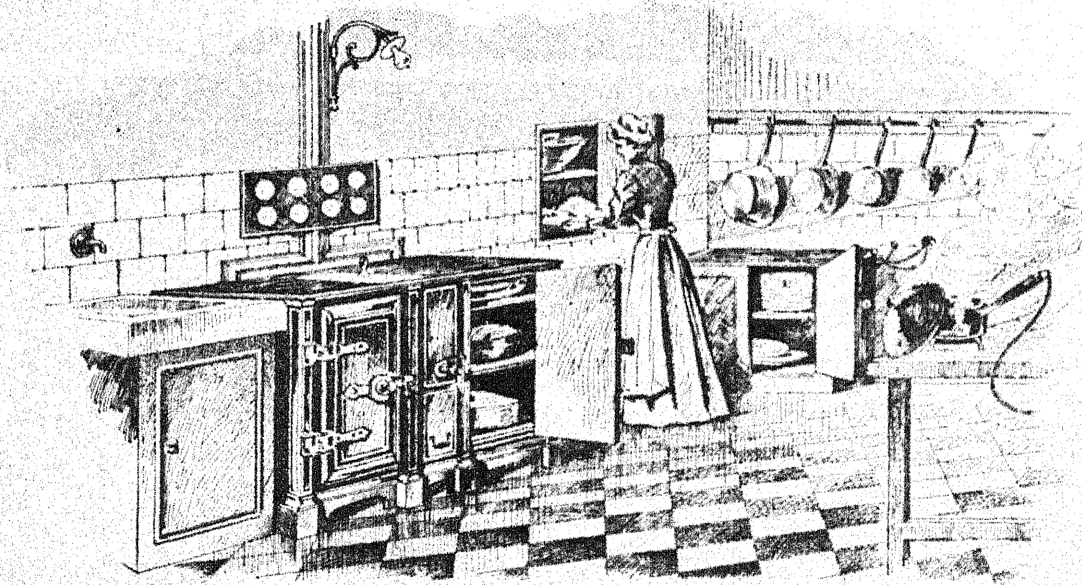


Fig. 555.—An Electric Kitchen.

before the oven is required in order to attain the necessary degree of heat; and there is no risk of finding that one side of the oven has been nearly red-hot, and has charred the eatables on one side, while the other is unbaked; or that the fire, not having been regulated with sufficient nicety, has either burnt the eatables or left them quite uncooked; for, by the peculiarities of construction above referred to, not only can we surround an electric oven with heating-surfaces on all sides, top or bottom, but, by merely turning the handle of a switch, we can regulate the current passing through these heating-surfaces, and consequently the degree of heat which any part of such an oven may attain, as shown in fig. 556. Thus, in an oven with six switches, all can be turned on to bake a certain article, and if this is not immediately required, all but one may be turned off, the remaining one being capable of keeping it warm. When we consider also that such an oven can attain its fullest heat in about 10 or 15 minutes after being first switched on, and can be turned out im-

mediately after use, we can at once see that the efficiency of electricity used in this direction is very high, and the cost consequently low; on the other hand, as all unnecessary heat is waste, the burning down of a coal-fire after use in cooking is dead loss. Nor is the evil of loss up the chimney only confined to the householder bearing it, for, as anyone living in a large town may see, it is these small contributions, and not those from mills and workshops, which make the atmosphere in all great centres what it is, ruinous alike to health and property.

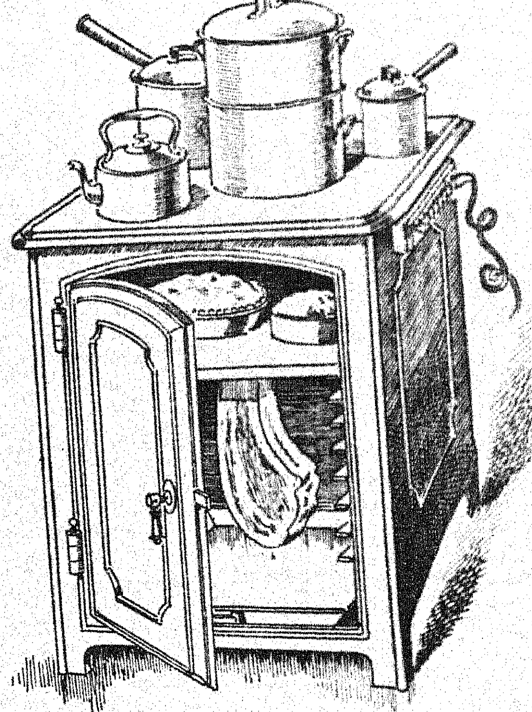


Fig. 556.—An Electric Oven.

Now as to cost. The energy will probably be obtained from an electricity supply station; for as electricity can be generated more cheaply on a large scale than on a small one, this is, with small consumers, the cheapest method of obtaining it. In Great Britain electrical energy is usually generated from steam power, and the price for current used for heating and motive purposes is about 2*d.* per unit.[1] For lighting, a higher rate is usually charged. In places where generating power can be obtained more economically, electrical energy is cheaper, for instance, in parts of America and the Continent, where electricity can be produced from large flows of water. We will assume that 2*d.* per unit is a fair standard on which to base our calculations, this being the actual amount now charged by many electricity supply stations for such purposes, though it is much higher than that at which an ordinary large private installation could supply it. We find that in an electric kettle 1 lb. of cold water can be boiled in approximately three minutes, with a current of 10 ampères at a pressure of 100 volts, which works out into units as follows:—

$$100 \text{ volts} \times 10 \text{ ampères} \times \tfrac{3}{60} \text{ hour} = 50 \text{ watt hours;}$$

[1] By a "unit" is meant 1000 "watt hours", a watt being the standard of electrical energy, obtained by multiplying the pressure (or "voltage") of the circuit by the current (or "ampèrage") absorbed by any particular apparatus; in other words, when the electrical energy, multiplied by the time in hours, equals 1000, a unit of electricity has been expended. The definitions of the terms used in connection with electricity will be more fully given in the chapters on Lighting by Electricity, Section XII., Part I.

this, at *2d* an unit, works out thus—

$$1000 : 50 :: 2 : \tfrac{1}{10} \text{ of a penny.}$$

An oven like that illustrated in fig. 556 will, with a pressure of 100 volts, take a current of approximately 25 ampères for about $\frac{1}{4}$ hour, by which time full cooking temperature of 325° to 400° Fahrenheit will be attained. After this first quarter of an hour a current of only 10 to 15 ampères will be sufficient to maintain this degree of heat.

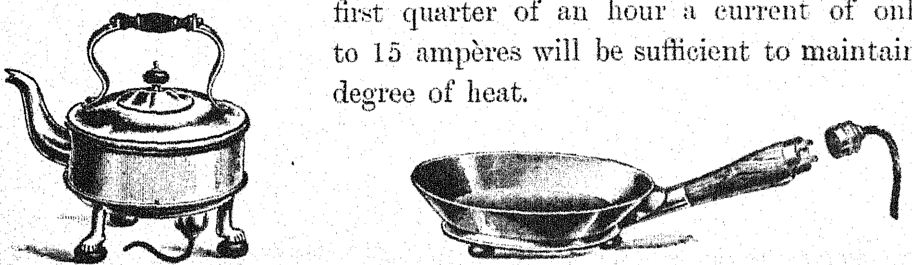


Fig. 557.—Electric Kettle and Fry-pan.

Care should be taken in the purchase of cooking or heating goods that they are built to suit **the pressure of the consumer's circuit,** for such pressures vary, and it will readily be seen that applying current at too great a pressure results in more current being forced through than it is capable of receiving without damage to it through overheating.

Small appliances, like kettles and other movable objects, usually get their connection by means of **two flexible silk-covered wires** in the form of a cord, at the end of which is a plug carrying two small metal terminals, which can be pushed into sockets fixed in different places on the wall for the purpose. This arrangement will be better understood by reference to the drawing of an electric fry-pan, shown in fig. 557. By means of the current supplied through these cords water can be boiled or kept boiling on the table where it is to be actually used. In the same way, flat-irons (fig. 558) can be coupled by means of the flexible cord through which the current passes, and as the electricity warms the iron while in actual use, there is no necessity for heating more than one iron, hence there is a considerable saving in time and labour.

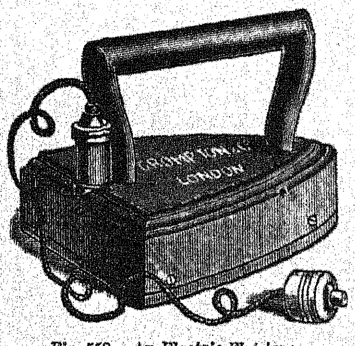


Fig. 558.—An Electric Flat-iron.

Other portable objects, such as curling-iron heaters, small radiators, cigar-lighters, foot-warmers, &c., can be heated in a similar way, in any position in which they are most useful. One of the most striking instances of efficiency in this direction is given by the electrical foot-warmer, which consumes a current

of one ampère only, which is little more than that taken by an ordinary incandescent light; with the unit at 2*d.*, such an arrangement in actual use would cost only $\frac{1}{5}d.$ per hour.

The efficiency of appliances of this description may be said almost to be perfect, since kettles and similar utensils have an efficiency of 80 to 90 per cent, and hot-plate warmers have an efficiency of from 90 to 95 per cent. By using a grill arrangement of hot plates similar to those just mentioned, a current of 5 ampéres at 100 volts will, in about 10 minutes, raise the apparatus to cooking-heat, while another 10 minutes, at a slightly reduced current, will be sufficient to cook two chops, which will thus be done at an expenditure of less than $\frac{1}{2}d.$, an amount which in many cases will hardly cover the cost of the chips used in lighting a coal-fire in an open range. Such an example, however, does not show the electric grill in its best light, as operations began with everything cold; if we continue to cook chops on the grill when the first two are finished, we shall find that the outlay will be less than $\frac{1}{4}d.$ per couple.

In the choice of cooking-appliances, it should be borne in mind that self-contained apparatus are the most efficient; that is to say, those articles in the bodies of which the heat is actually generated, as, for example, the oven shown in fig. 556.

It will be manifest that **heating is almost identical with cooking,** both as regards appliances and cost. The only necessity is to convert the hot cooking-plate into something possessing a more artistic appearance, and then call it a radiator.

Electric radiators are made in many shapes and patterns, and quite ornamental in appearance. Their utility is manifest; not only do they do away with vitiated atmosphere from products of combustion, but they are under perfect control, and can be turned on or off as readily as any incandescent lamp.

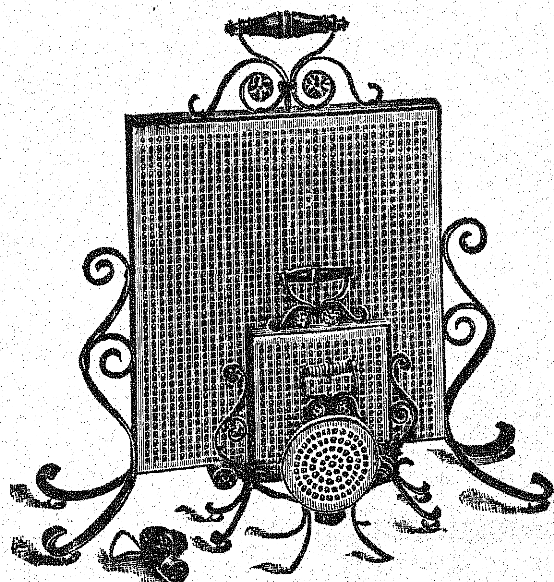


Fig. 559.—Electric Radiators in the form of Screens.

Radiators for private houses, instead of being built as fixtures, are usually made portable in the shape of screens (fig. 559), or luminous heating lamps with reflectors (as shown in the side recesses in fig. 560), or boxlike receptacles

with heating coils (like the central part of fig. 560). In some radiators of the third type one or more ordinary incandescent lamps, with burnished metal reflectors or coloured glass screens, are fitted in order to give a bright appearance. All portable radiators possess the additional advantage, by means of their flexible connections, of being readily movable, and while, generally speaking, heating by such means is comparatively expensive, the advantage of being able to apply it quickly in any particular spot is, in many cases, invaluable.

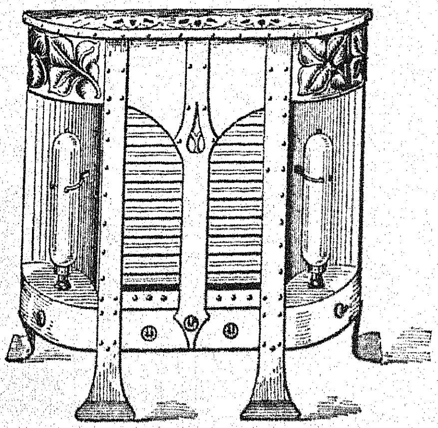


Fig. 560.—Luminous Electric Radiator.

The more general application of electricity to cooking and warming would, undoubtedly, purify the atmosphere and reduce labour, and thus not only tend to prolong life, but to make it easier and more pleasant.

Separate meters ought to be provided for recording the current consumed for heating and for lighting, and the wiring for the two purposes ought also to be quite distinct, as in nearly all districts supplied with electricity by public companies the rate charged for current used for heating is 50 per cent (or more) less than that charged for current used for lighting.

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DEDICATION

This book is dedicated to my uncle George, for the grounding he gave me in nature study; to the many companions on fishing trips; and to the heart of India, found in her people—the most hospitable in the world.

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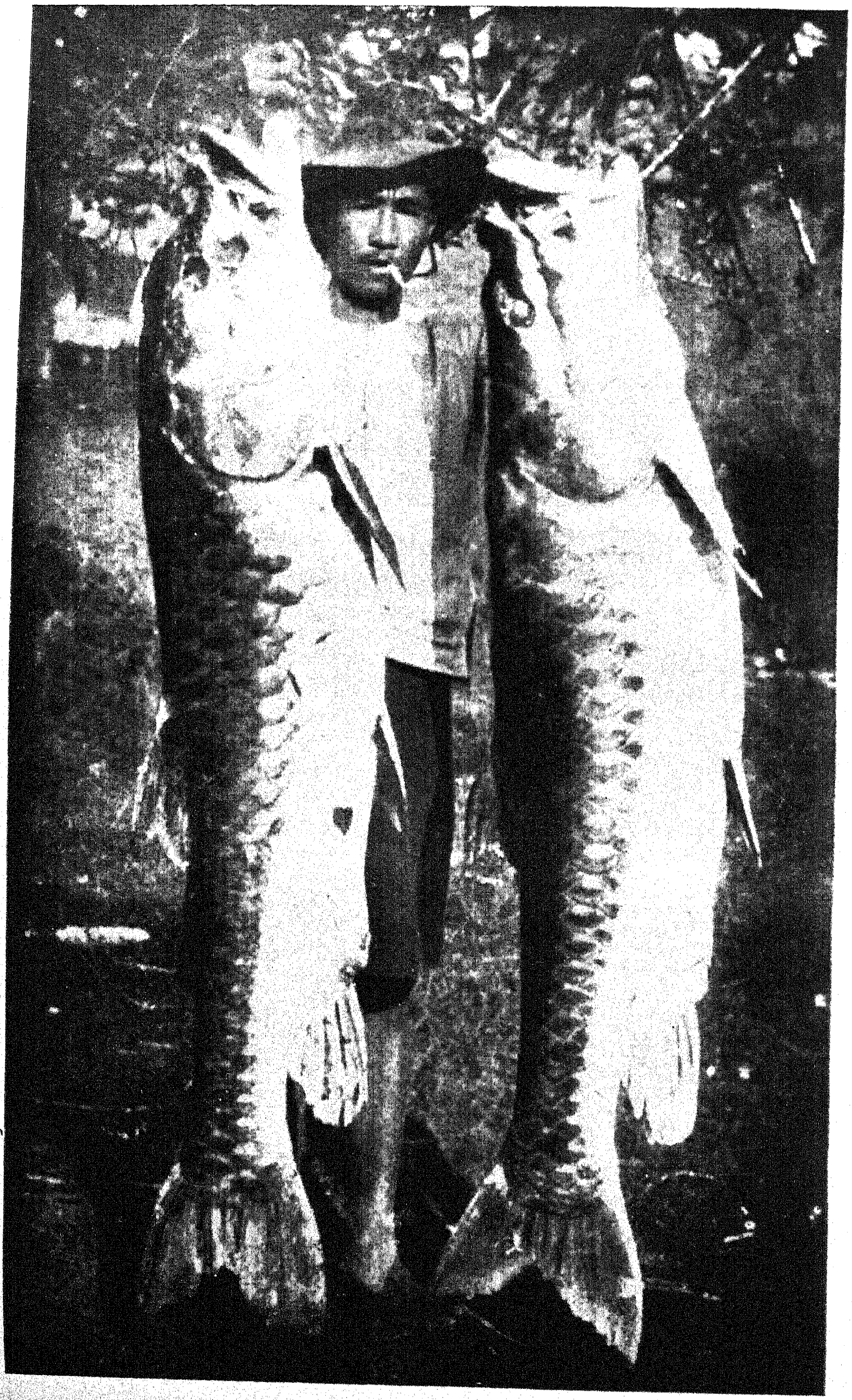

A BRACE OF 'GRANDMOTHERS'

55 and 75 pounds taken at the famous Confluence N. of Myitkyina.

INTRODUCTION

It is chiefly because I have been pressed by friends, both through the press and directly, and that the last book published on Indian fishing is eighteen years old (*The Mighty Mahseer* by Skene Dhu) that I am attempting to write this account. A series of articles on the 'Game Fishes of India' by Dr. S. L. Hora is being published in the *Journal of the Bombay Natural History Society*. It is written mainly from the scientific aspect and is directed to provide accurate information about the status and distribution of Indian Game Fishes. If one is to write about 'Mahseer', one should in the first instance know what species of fish one is writing about. At present we do not know how many different species of fish are included under the name 'Mahseer'. Dr. Hora's work is directed to unravel these and other problems. The present work deals with the subject, purely from the fisherman's point of view. It has been my intention to write chiefly for the young angler, and for those with less experience than my own, and to provide all the information required without having to purchase for a start the other books published on fishing in India.

For this reason I have included much that would appear unnecessary to the possessor of the *Rod in India*, or other works. I have tried, further, to include here information which has not deen dealt with previously, but which will be of interest to anglers in general.

I have refrained from giving long narratives of fights with fish, or large bags made; these are beside my object. I wish to see ten rods fish in the place of one, and to encourage the study of the mahseer.

I will ask the reader to bear in mind these aims. What I have written is written by an angler for the angler. I offer little to the experienced, merely the point of view of the individual. My aim is to help some to catch more fish than they already have done, and to others to start at the beginning. This work does not presume to have any literary value, or any interest outside the subject to which it is devoted. It is an endeavour to impart knowledge of the subject, to those prepared to accept my simple expression based on experience, of the best ways to master the many aspects of angling in India and Burma.

I offer my advice for what it is worth, so that it may be a guide and help in starting you off on an angling career to obtain sport as good as any in the world; for a fish that takes two to three minutes per pound to kill, on fly rod and light tackle, cannot be despised by any angler. I refer of course to the mahseer, to which this book is chiefly devoted.

Eighteen years is a long period of time to cover. From the angler's point of view, much of the water that was good has been spoilt either by canal systems or development; but there is still plenty of scope for the keen angler, and sport is as good. I have perhaps neither the qualifications nor the experience of many others

in the country today, but I have waited 18 long years for a lead and to all of you whose experience outweighs my own, this is my answer!

Nine years ago I was approached, as I have already said, to write a book on fishing; after much correspondence and trouble I got it compiled. I derived a great deal of pleasure in doing so, but the publishers fought shy, as the expense of publication would not, in their opinion, be covered by the demand for such a book in India and Burma. It was full of maps, sketches, and photographs, but not any more than a book by a plant hunter or big game writer. Why big game in India can stand so much publication (almost a book or two a year), and fishing not one in 18 years I fail to understand. Especially as there is almost a boring repetition of facts appearing in recently written shikar books; nor can it be that for every man keen on big game less than one in eighteen is an angler! However, the fact remains that the book was not published. Now, to meet the still pressing demand, I have cut down maps, sketches, and photographs to a minimum; and to keep within the limits of publication, and publishers' fears, I have condensed the original book into 250 pages of twelve chapters.

The chapter on practical Natural History, which is in a strict sense not about natural history as the 'giants' know it, but a simple and straightforward way of studying fish for purposes of identification and should not deter the reader who need have no fears of being bored by long lists of Latin names and technical definitions. There is nothing in this chapter with which a good angler should not be familiar.

I am indebted to Dr. Sunder Lal Hora, Director of Fisheries, Bengal, and Dr. T. J. Job for kindly going through and rearranging the chapter, and to Dr. Hora's artist for the excellent labelled drawings of the Putitor Mahseer.

I have also dealt with the scientific aspects of angling not hitherto touched on by any of the writers on Indian fishing; in fact there is much in contradiction to their interpretation of the senses of fish, and their reaction to artificial lures. In order to elucidate the practical interpretation of the senses of a fish it has in the first place been necessary to quote freely from the world authority, Norman, and others, so as to acquaint the reader with facts about fishes not generally understood, and which do not ordinarily come his way. The practical application of the senses as applied to angling are of course my own, based on individual experience. Only a practical test will convince the angler whether my interpretation is right or wrong.

Hints to the Novice on the subject of tackle, with aids to its selection from confusing price lists and catalogues; a few general remarks on casting with fly and spinning rod; the points to remember while playing a fish; where to look for fish; with a few suggestions on kit and the conditions likely to be met with on a fishing trip have been included. Most of these are dealt with again, and in more detail.

The subject of 'Tackle for Mahseer' has been subdivided for purposes of convenience into heavy, light, and medium fishing. More

detail has been given in dealing with the selection of tackle, the trying of traces, knots, mounting spoons, etc.; and there is a list of a few tackle dealers in India.

'Fishing for Mahseer', covers a fairly wide field, embodying all the many aspects and considerations likely to influence the angler and fish; with a sketch map of a stretch of river, 'lettered' to assist in recognising good water. Most of the chapter is devoted to spinning for mahseer; but gram, paste, and dead bait fishing are also discussed. I propose to include a short account dealing with the 'Other Sporting Fish' and how to circumvent them. It has plates of most of the commoner fish likely to be taken. I have devoted some attention to Burma, giving full page illustrations of six forms of mahseer I caught, with details of the colouring, which should be found interesting; also full notes of bags and sizes of fish taken around Myitkyina. The account of fishing in Assam is a reproduction of letters and notes kindly sent me by the many sportsmen and anglers with whom I got in touch, through the curators of the Bombay and Darjeeling Natural History Societies. The plates of the teeth of mahseer and carp are most interesting and instructive.

'Tank angling', is dealt with briefly, and has two valuable notes on Cutla fishing.

'Sea and estuary Fishing', gives sufficient reference to guide those interested to good sport.

In 'Scraps from my Note Book', will be found general information necessary and useful to all fishermen.

If this series of articles justifies my conviction that there are more anglers in India than publishers imagine, a full and up-to-date book might follow.

I think, myself, that this is an unsuitable time to publish a book, but it has compensations for those of us who have had 'cold water' thrown on all our efforts to join the Forces, and to the many civilians and soldiers whose lot it is to stick it out in administrative posts which have to be held in times such as these.

In conclusion, I take the opportunity of thanking all those anglers, who nine years ago so readily responded to my requests for notes, and went to the trouble of making maps and sending photographs. I hope that at no great distant date these will prove useful in a book on Localities.

To the tackle dealers I tender my apologies should I have unduly criticised goods; it is with no intention of disparagement but solely to illustrate my point, and to improve tackle generally.

To the critic! This is a beginning; yours is the last word! The substance of these articles is based on good bags and results; if you can offer better, I shall be the more pleased.

CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA

CHAPTER I

Mahseer Fishing as compared with other Sport.

Children angle for minnows with bent pin and cotton thread, big game sea fish are captured by their parents with specially devised rods and appliances. Each in its own way provides the sport that is sought.

As I am dealing with mahseer chiefly, and other fishing generally, it will suffice for the present to write a few words as to what mahseer fishing really means.

The mahseer is essentially a fish of the rocks, the rapids, and the hills. In his quest for this fine fish the angler is taken into wild surroundings amidst some of the finest of nature's scenery. It may be that he will find his sport in the Himalayas, where is the grandest scenery in the world, and where the turbulent river winds its way through dark gorges clad in fir groves and rhododendrons, with perhaps a glimpse at the head of the valley of the Eternal Snows—'the stainless ramps of huge Himâla's wall', where the snow-fed torrent has its sources; or perhaps he will be wielding his trout rod amid the charming scenery of the valleys of Kulu or Kashmir.

The scene, again, may be along the banks of rivers in Garhwal or Kumaon, where the deep gorges are most oppressively hot, or in the lakes of Kumaon in a lovely climate. Then perhaps his efforts may lie in southern India, the yet secure home of elephant and bison, where unknown and almost impenetrable forests rise like a wall from the banks of the stream, and in which even people of the aboriginal tribes can become lost amid the tangle of mountains and vegetation; or it may be that he is wandering along the many streams of the Western Ghats, in enjoyment of the marvellous scenery peculiar to the favoured climate of Mysore.

A few days in a ship or train, and the fisherman can be in Burma or Assam, in pursuit of that monster mahseer of his dreams, which he will perchance find at the 'Confluence', or in one of the tributaries of the mighty Brahmaputra. In those lands the waters beloved of the noble mahseer are fringed by giant bamboos waving their graceful fronds over the placid depths, or by splendid trees whose immense serpentine roots are washed by the roaring rapids. There will be the dense retreats of the wild elephant, the secure cover for bison and other game, the last barrier put up by long-suffering nature against the ever destroying hand of man.

In the upper story of forest trees, growing straight and tall, their branches wrapped in mosses and orchids and fringed with ferns, the gibbons sport and play. Often will their far-sounding

cries be heard, but seldom will the animals be seen; so with the birds which call and twitter in the jungle thickets, and so with the peacock, pheasant, jungle fowl and all the life in those teeming evergreen forests. In the few open spaces and at the crossings of the streams, will be those swarms of fluttering butterflies of gorgeous hues which congregate at such places; and strange little flowers peep timidly from amongst the vegetation which smothers all the land.

Shooting, fishing, painting, photography, are all in abundance for those who will venture into the wild places where pursuit of the mahseer will lure them. The thrill of a big mahseer, hooked in heavy water, hurling himself down the rapid with express speed to the tune of a fast emptying reel, has an electric joy apart from any other sport. There is nothing quite like it; and once experienced it is imprinted for ever on the tablets of memory. Many a sportsman has truly said that he would rather catch a big mahseer than shoot a tiger.

I have been fortunate in enjoying many of the varied kinds of sport obtainable in India; and, were I given to comparison, would place mahseer fishing second only to pig-sticking. The days available to the votary of the spear are all too short, for, with the passing of the years age must give way to youth; but at least we can fish while health and eyesight last.

It is not perhaps fair to make comparisons. The whirr of a rising partridge, the swoop of a flighting duck, the call of the Koklas pheasant, or the gorgeous Monal as he hurtles through the pines; the mad gallop with the bobbery pack in pursuit of fox or jackal, the yet more reckless pursuit of the great grey boar; is each in its own place akin to that heart-beat when the driven tiger approaches the waiting sportsman, with that moment when at last one closes into action with the elephant or bison tracked since dawn. At all such times one is spellbound by the intense enjoyment of the moment; but the instant of contact with a heavy mahseer, be he of the two or three score pounds, in the racing rapids of a river, is a thrill unsurpassed in any other sport.

The varied joys and excitements of a fishing trip in wild places are a panacea for all worldly cares and troubles. The quest of the mahseer will take the young soldier, or civilian, or those many others who are entering into various walks of life in the East, among wild places and peoples where will be gained that self reliance and poise of character which is the outcome of responsibility. In close contact of the many varied people of the land will much knowledge be gained which can be acquired in no other way.

Fishing is a sport which can meet many tastes and pursuits. The painter, the hunter of big game, the entomologist, the botanist, the ethnologist, in fact all the ologists will find interest and refreshment apart from the actual fishing; there, also, will be found that solitude in communion with Nature which is the Mecca of all lovers of wild life.

It is to Burma in particular that my love is given. The wild scenery, the giant trees, the multi-coloured orchids, the birds and butterflies of brilliant hues, and above all the pleasing and cheerful

people—the Burmese and Shans, the Chins and Kachins, attract me in a way apart from the fascinations of other countries in the East.

Have I dwelt too long upon the joys and attractions in the quest of the mahseer? In what better way can a holiday be spent than in pursuit of the elusive Barbus tor? It has been my endeavour in the following chapters to provide the answer.

CHAPTER II

Simple Natural History of the Mahseer.

Angler's part in Natural History (1). Popular names (2). Form of body (3). Body proportions (4). Fins (5). Scales (6). Lateral line (7). Barbels (8). Age (9). Sex (10). Colour (11). Formula for Field Notes on Mahseer catches (12). Food and feeding habits (13). Migration and Spawning (14). Size and distribution of Mahseer (15). The Black Mahseer (16).

In this chapter I am merely endeavouring to put before the angler certain facts that will come within his ken, and aid the making of notes by which he can do much service to Ichthyology and a greatly neglected subject, the study of one of the most sporting fishes in the world, the Mahseer of India and the East. The immortal Thomas in 1873, 1881 and again in 1897, published the classic 'Rod in India', and other lesser books have followed in its wake. They, however, have been written almost solely with the object of showing the way to sport rather than of combining with fishing the study of the fish that provides that sport.

This much have I aimed at: To show in simple form how to recognize the many varieties of the fish that has afforded such grand sport ever since the British came to India, and of which we still know comparatively very little; and to make notes of interesting points, which often catch the eye of the Angler, but which, alas, seldom receive the attention and publicity which they deserve.

1. *The Angler's part in Natural History.*—The Angler can be the best friend of the Ichthyologist. Simple notes such as are suggested in this chapter will enable the 'Pundits' to arrive at scientific results; we anglers can be their field naturalists. Observations made intelligently and with that enthusiasm in the subject I am asking fishermen to attain, will be of the greatest value, and most gratefully appreciated by the staff of the Bombay Natural History Society. It takes but a matter of five or ten minutes to note down the necessary details as to any unusual fish (data required will be found later on), and the preservation of a specimen in formalin is most simple. So to all anglers reading what I have written I make an appeal for help in elucidating all that has to be learnt about the Mahseer. Some may say, 'What does it matter whether a fish is a Black, Red or a Green Mahseer? I am out only for the sport, and so long as I get that, I am satisfied'. The answer to that is that to fish for sport only, without a thought to the aid of Science in learning all that there is to know of the fish, becomes mere body-snatching; no true sportsman, once enlightened in the matter,

can for long retain that attitude of mind; and should these articles of mine make even a few converts, and result in but a few specimens and notes being sent in to the Society, I would feel it sufficient reward for my labours.

A good deal of what follows I owe to the works of the late H. S. Thomas (1897), of Sir Reginald Spence and Mr. S. H. Prater (1932), of Professor Neilson (1934), of Mr. J. R. Norman (1931) and of Dr. S. L. Hora (1939—).

Most of the fishes of any importance to the angler belong to two families—the Cyprinidae or Carps, and the Siluridae or Catfishes. The Mahseer belongs to the Carp family. But he is very different in size, flavour, strength, activity, and so forth, to his ignoble namesake in England. Hence you had better call him a Barbel. The status of the Mahseer is very much disputed. A number of species seem to inhabit the waters of the Indian Empire. Thomas (p. 27) writes, 'Further experience has confirmed me in the view advanced in 1873, that there are more Mahseers than have been named, and that if it were possible that as much accurate attention could be given to the Mahseer as has been devoted to the Salmonidae of Great Britain, of Europe, and of America, it would be found that the Mahseers of India would likewise grow in numbers'.

Thomas's prophecy has come true, for, in his recent series of articles on the 'Game Fishes of India', Hora has shown that at least 4 to 5 kinds of Large-scaled Barbels are found in the Himalayan waters.

2. *Popular names.*—Mahseer are known by numerous vernacular appellations in different parts of India and Ceylon, such as *Putitor* (Goalpara); *Tor* (Rangpur); *Săhăra* and *Tŭrĭyă* (Purneah); *Măsăl* (Kosi R.); *Kajra* (Dáŭdnagar, Sone R.); *Burapaira, Junga Peetia* (Assam); *Naharam* (Hindi); *Kukhiah* (Punjab); *Kurreah* (Sind); *Kendi, Bŏmmin* (Tamil); *Peruval, Harale-minu* (Canarese); *Hăllă-minu* (Mysore Canarese); *Meruval* (Malayalam); *Heragălu, Peruval* (Tulu); *Kadchi, Barsa Masla* (Marathi); *Kuriah, Lela* (Sinhalese). Fishes throughout the world appear to have more local names given to them than any other animal. Various opinions have been expressed about the etymology of Mahseer. Lacy and Cretin (1905, p. 2) observe, 'The derivation of Mahseer from *maha sir*—big head—may be merely an attempt to give a meaning to the word. The derivation from *maha sher*—big tiger—is fanciful, although the natives sometimes pronounce the word 'Mahseer'; it is merely the soft equivalent of the word. A third and a good derivation is from *Massulah*, *Mahasalka*—big-scaled. The natives often call the fish *Mahsol*. The Mahseer has got bigger scales than any other fresh-water fish in India. Its big scales form one of its most distinctive characters. A big Mahseer has got scales as big as the palm of one's hand, which make the use of the gaff unsafe. The scales are used as playing cards in some parts of India. A fourth, and a likely, derivation is from *Matsya*, which is the Sanskrit word for 'fish', and is used in the Vedas. As the Mahseer is a sacred fish, preserved

near many Hindu temples, it is probable that the Brahmans called it 'Fish' *par excellence,* pronouncing the word 'Mahsia'. More recently Hora has dealt with this point exhaustively and is of the opinion that Mahseer is very likely a colloquial form of *Mahāśirasha* or *Mahāśiras,* the bigness referring to the front part of the fish and not merely to its head or snout.

I propose to describe below how fishes are identified and to give the general features of the Golden or the Common Himalayan or the Putitor Mahseer, *Barbus* (*Tor*) *putitora* (Hamilton); pointing out the peculiarities of the other species so far recorded from North Indian and Burmese waters with their geographical distribution.

As with other classes of the Animal Kingdom, Fishes are divided into various sub-classes, orders, sub-orders, families, sub-families, genera, sub-genera and species, the classification being based on resemblances or differences in structure. The cartilaginous fishes, such as sharks, skates and rays, differ so obviously and fundamentally from the bony fishes, that the former are grouped together in a separate sub-class. But in spite of certain structural resemblances they differ among themselves in certain characters so that this sub-class is sub-divided into an order to include all the sharks, and another to include all the skates and rays. The family is a group of fishes within an order or sub-order, possessing certain general features in common. Different members of a family, in accordance with particular affinities, are grouped into separate genera. The members of a genus or even of a sub-genus are themselves distinguished from one another by specific differences, usually indicated in the nature of the teeth and fins, in the number and arrangement of the scales, and other anatomical details. Thus we come ultimately to the species. It has to be remembered that even among the members of a species no two individuals are ever perfectly alike, and minor individual variations are bound to be met with. These, however, are hardly of any specific significance. In scientific nomenclature a fish gets a double name, the first word representing the genus, and the second the species. The name of the author who first described the species usually follows. In certain cases another name is included between the generic and the specific name to signify a sub-genus. Thus the common Himalayan Mahseer is scientifically known as *Barbus* (*Tor*) *putitora* (Hamilton), where *Barbus* is the generic name, (*Tor*) is the name of the sub-genus, *putitora* is the specific name, and the fish was first described by Francis Hamilton. From the foregoing account it will be seen that the classification and identification of fishes is based on resemblances or differences in their anatomy. An attempt is made here to explain with special reference to the Mahseers the main external characters on which the differences are based, and some of the terms and abbreviations commonly used in scientific descriptions of fishes.

3. *Form of body.*—Fishes are usually boat-shaped, being longer than broad or deep, and adapted for swift movement in water. Variations from this typical form, however, are not rare. The body of a Carp is said to be Compressed, *i.e.,* flattened from side to side, while that of a Catfish is said to be depressed, *i.e.,* flattened vertically.

The Putitor Mahseer (fig. 1) is an oblong, somewhat compressed, streamlined, trout-like fish in which both the profiles are gently and gracefully arched. The head is broadly pointed anteriorly

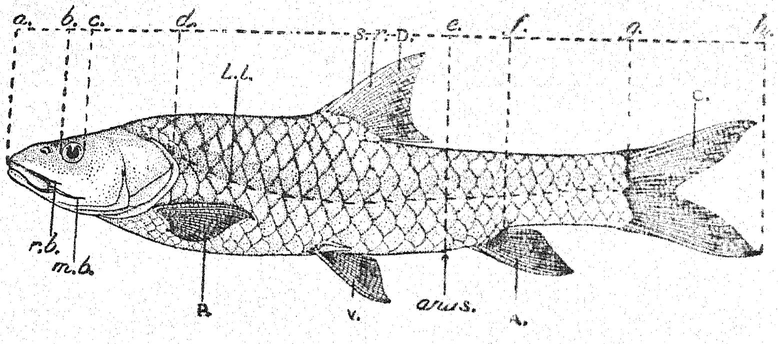

FIG. 1.—The Putitor Mahseer, *Barbus* [*Tor*] *putitora* (Hamilton).

(1) a-d. Length of Head (contained 3 to 3.6 times in standard length. *ag*).
(2) b-c. Diameter of eye (contained 2.8 to 5.3 in length of head. *ad*).
(3) a-g. Length of body (standard length).
(4) a-h. Total length of fish.
(5) e. Anus.
(6) a-b Length of snout.
(7) f-g. Caudal peduncle (the least height of caudal peduncle is contained from 1.4 to 1.8 times in its own length).
(8) L.l. Lateral Line (25 to 28 scales. 26 in Plate).
(9) L. tr. Lateral transverse. $4\frac{1}{2}/2\frac{1}{2}$. This represents the number of transverse rows of scales between the middle line of the back and the ventral fin. Here there are $4\frac{1}{2}$ rows above (up to the base of the dorsal fin) and $2\frac{1}{2}$ rows below (up to the base of the ventral or pelvic fin, counting in each case to the lateral line).
(10) Barbels. m.b. maxillary (from the upper jaw).
r. b. rostral (from the snout).
(11) Paired Fins. P. Pectoral.
V. Ventrals or Pelvics.
Vertical Fins. D. Dorsal.
C. Caudal or tail fin.
A. Anal.
(12) Fin Rays. (s) Simple or spine.
(r) Soft or branched.
(13) The depth of the body is the vertical distance between the dorsal and ventral surfaces at the deepest part.
(14) The girth is the measure round the stoutest part.
(15) Fin formula of Figure 1. D. 4/9. A. 8. P. 17-18. V. 10. C. 19.

and behind the anal fin the tail becomes considerably narrow. The gape of the mouth does not extend to below the eyes; it is horizontal with the opening obliquely directed upwards.

The lips are fleshy and continuous at the angles of the mouth; the lower lip (fig. 2 *b*) is produced into a median lobe and the post-labial groove (*p. l. g.*) is continuous. The condition of the lips varies greatly in individuals of different sizes and in those collected from different localities. It is highly desirable that anglers may kindly note the condition of the lips of the Mahseers caught by them and also make a detailed note of the length.

4. *Body proportions.*—Fishes, as a rule, continue to grow as long as they live, and hence the actual length of a specimen is of very little significance in its identification. But the relative lengths of the different parts of a fish remain constant. The body proportions

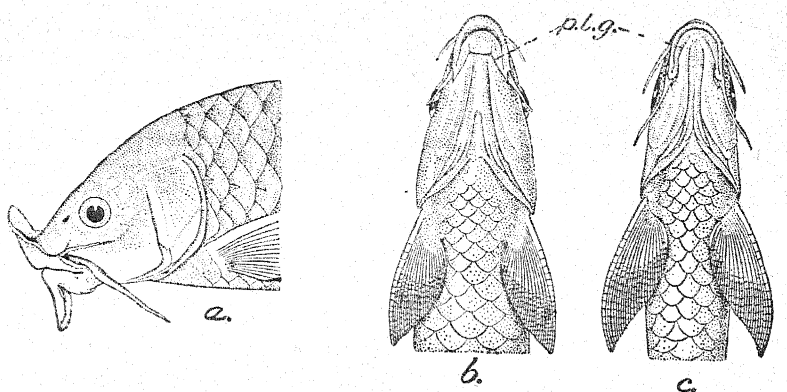

FIG. 2.—Oral features of Mahseers.

(*a*) Side view of head and fore part of body of a true Mahseer of the *Tor* type, *Barbus* (*Tor*) *tor* (Hamilton), showing hypertrophied lips extended. For purposes of drawing, the lips were drawn out to their fullest extent. *In nature the enlarged lips, however, remain compressed and neatly folded, and conforming with the general contour of the head.*

(*b*) Ventral view of head and fore part of body of *B.* (*Tor*) *tor* (Hamilton) showing the continuous post-labial groove and the enlarging lips with the median lobe of the lower lip.

(*c*) Ventral view of head and fore part of body of a *Lissochilus*-type of Mahseer, *Barbus* (*Lissochilus*) *hexagonolepis* (McClelland). Note the interrupted post-labial groove and the normal lips.

p.l.g. = Post-labial groove.

may vary in young specimens, and therefore the measurements of fairly adult specimens are reckoned. The *total length* of a fish (fig. 1 *ah*) is measured from the tip of the snout to the end of the tail fin. The *length of body* or *standard length* (*ag*) is the distance from the tip of the snout to the origin of the tail fin. The *length of head* (*ad*) is the length from the tip of the snout to the hind margin of the bony part of the gill cover. The *depth* is the vertical distance between the dorsal and ventral surfaces at the deepest part. The *diameter of the eye* (*bc*), the interorbital distance; length of snout (*ab*), *i.e.*, the portion of the head in front of the eye; the *length of caudal peduncle* (*fg*), *i.e.*, the distance between the last ray of the anal fin and the origin of the tail fin; the *least height of caudal peduncle*, etc., are also measured. The girth of the fish is the measure round the stoutest part. The tail (*eg*) in the scientific sense is the portion of the body behind the anus, though in the popular sense the tail may include the tail fin also.

In a scientific description of *B.* (*Tor*) *putitora*, one reads as follows:—The length of head is contained from 3 to 3.6 times in the standard length. The depth of body is contained from 1.1 to 1.4 times in the length of head. The diameter of the eye is contained

from 2.8 to 5.3 times in the length of head, from 0.8 to 1.7 times in the length of snout, and from 0.7 to 1.4 times in the interorbital distance. The least height of the caudal peduncle is contained from 1.4 to 1.8 times in its length.

5. *Fins.*—According to the position the fins of fishes come under two categories: the paired fins and the vertical fins. The paired fins consist of a pair in the fore part of the body, one on each side, called the pectorals (P) and a second pair below the pectorals, on the lower surface of the fish, called the ventrals (V) or pelvics. In some fishes either or both of these may be absent. The fish uses the paired fins mainly for balancing itself in water. The vertical fins are the dorsal (D) on the middle line of the back, the caudal (C) or tail fin and the anal (A) in the middle line of the belly. The tail and its fin constitute the chief swimming organ of the fish. The bony rays which support a fin may be either simple or branched and articulated (composed of numerous branched joints which render the fin flexible). Simple rays are called spines (*s*), while the others are described as soft rays (*r*). Some spines may be soft and flexible, but they are distinguishable from true soft rays by their plain unbranched nature.

Thus the fin formula of the specimen of the Himalayan Mahseer figured here as:—D. 4/9; A. 8; P. 17-18; V. 10; C. 19 indicates that the dorsal fin has 13 rays of which 4 are spines and 9 soft rays; the anal has eight rays; the pectoral has 17 to 18 rays; the ventral has 10 rays; and the caudal has 19 rays, all soft. In the Himalayan Mahseer 'the commencement of the dorsal fin is opposite to that of the pelvics, and is almost midway between the tip of the snout and the base of the caudal fin. The last spine is very strong and bony; it is generally shorter than the depth of the body below it, but in some individuals it is equal to the body height. In a specimen from Murree, however, it is considerably longer than the depth of the body. The pectoral fins are low, considerably shorter than the head and sharp above. The pelvic fins do not reach the anal opening. The anal fin does not extend to the base of the caudal fin. The caudal fin is sharply divided, with the lower lobe somewhat more pointed' (Hora, 1939, p. 278).

6. *Scales.*—The skin of fishes is either covered with scales or naked. Some parts like the head and fins are more often naked than scaly. Scales of fishes are horny elements developed in grooves or pockets of the skin like hairs, nails or feathers of the higher vertebrates. Scales as those of carps, with an entire hind margin and a concentric striation are described as cycloid. The number of scales along the lateral line, as also the number of rows of scales above and below the lateral line, are often of specific significance.

7. *Lateral line* (L.l.) is the line of perforated scales running along each flank of the fish. Beneath each pore is a group of sensory cells which perceive the slightest pressure changes in the surrounding water. The lateral line has nerves connected with the ear of the fish. The scale-counts in relation to the lateral line of *B.* (*Tor*) *putitora* are represented as follows:—L.l. 25-28; L. tr. $4\frac{1}{2}/2\frac{1}{2}$. This signifies that there may be from 25 to 28 scales along the lateral line; L. tr. represents the number of transverse rows of

scales between the middle line of the back and the ventral fin, and in this case there are $4\frac{1}{2}$ rows above (up to the base of the dorsal fin) and $2\frac{1}{2}$ rows below (up to the base of the pelvic fin) the lateral line. The numbers of scales between certain other landmarks of the body also are sometimes taken into account. Thus in the Putitor Mahseer there are 9 scales before the dorsal fin (up to the head) and 12 round the caudal peduncle, and there is a well developed scaly appendage in the axil of the pelvic fin.

8. *Barbels.*—In some fishes as in craps skinny appendages called barbels or feelers occur on the jaws. According to their position they are described as *nasal* from the region of the nostril, *rostral* from the snout, *maxillary* from the upper jaw, usually at the corner of the mouth, *mandibular* associated with the lower jaw, and *labial* associated with the lips. The Putitor Mahseer has two pairs of barbels, one rostral (*r. b.*) and the other maxillary (*m. b.*), which are more or less of equal length.

9. *Age.*—The condition of the scales and otoliths is said to indicate the age of a fish. Definite growth rings have been detected in the scales of European fishes like the salmon. But the technique is still undeveloped in the case of Indian Carps. To be able to say anything definite, it is desirable that large numbers of fish of different species in diverse waters be examined in detail, and systematic observations made on their scales to elucidate the significance of the rings. The ear sacs containing the otoliths are situated on the sides of the base of the skull. The otolith is a bony concretion which increases in size during the entire life of the fish, each year adding two layers, a light one formed in summer and a dark one in autumn and winter. The number of pairs of layers represents the age of the fish. Here again, variations may occur, and the technique has yet to be perfected in the case of Indian fishes.

10. *Sex.*—Fleshy protuberances and hypertrophied lips (fig. 2*a*) have been suggested to have a sexual significance; but those characters are not reliable, and the crucial test is an examination of the gonads. But if it is difficult to be sure whether it is an ovary or a testis, the same may be preserved and sent, with other particulars, to the Bombay Natural History Society for further study.

The gonads occur as a pair of elongated, light-coloured, strap-shaped bodies lying one on each side of the intestines, and lodged in the groove between the air-bladder and the abdominal wall. Each gonad appears as a quill-like bag, which in the female shows little rounded dots of eggs which are absent in the male.

11. *Colour.*—There is a variety of colours among the different Mahseers, and even in the same species the colours vary considerably according to the nature of the waters inhabited by the fish. Here is Hora's description (1939, pp. 278, 279) of a nine-inch long specimen of *B.* (*Tor*) *putitora* freshly collected from the Tista river near Washabari Bazaar in the Eastern Duars:—

'The dorsal surface of the head and a small anterior portion of the body were found to be of a Lincoln green colour while the ground colour of the remaining portion of the dorsal surface of the body was warm buff which faded into light pink at the sides

and silvery white on the ventral surface. On the sides, between the upper angles of the gill-openings and the base of the caudal fin, there were broad bands of light mineral gray. Each scale was anteriorly marked with a gray blotch. The portion of the tail in front of the caudal fin was marked with an irregular, broad, vertical band of amber yellow. The operculum and the sides of the snout were of gray colour, while patches of orange and yellow colour were present on other parts of the head. The dorsal fin was light yellow in colour, while its rays were conspicuously yellowish gray. The fin was provided with a broad band of mineral gray across the rays. The pectoral fins were pink at their bases and citron yellow distally. The pelvic fins were yellowish with a tinge of pink at their bases and extremities. The anal fin was likewise citron yellow with pink extremity. The caudal fin was also citron yellow with its rays of mineral gray colour; it was edged with pink and gray.'

He further describes a $3\frac{1}{2}$ feet long specimen of the same species collected from another region of the Tista river and kept in a *kachha* tank at the Rungli Rungliot Tea Estate, Darjeeling District, as follows:—

'The back was reddish sap green and along the sides above the lateral line there was a broad band with a purplish shadow throughout. Below the lateral line the body was light orange which faded into silvery white on the belly. The head below the level of the eyes was light buff yellow which was replaced ventrally by a light neutral tint. The iris was light green while the pupil was dark blue. The scales in the upper half of the body were marked anteriorly by reddish sap green colour while in the centre they were brilliantly orange, their posterior edges were peacock green in colour with shades of light and deep sap green anteriorly. The pectoral, pelvic, and the caudal fins were peacock green in colour; the distal tip of the anal was marked with a patch of reddish orange, while the posterior border of the caudal fin was marked with reddish green. The tubes on the lateral line were greenish silvery.'

The best way to paint or draw a Mahseer would be to keep by one's side three or four sketches of the Mahseer in outline, keep the fish alive in the water beside you, and as the colours of the fish are noted down, put it back for a breather. In this way the most accurate notes can be made. If you put him on the bank alive, he will start changing colour noticeably, and by the time you have worked back to your first notes, the colour will have changed.

The resplendent hues of living fish are inimitable; you can almost see the changing hues and sheen-like colouring fade with the life of the expiring fish.

Notes, even though rough, and the colours approximately close to those of the living fish, are always valuable. Time in carrying out this difficult task is never wasted. As per Formula below:

12. *Formula for Field Notes on Mahseer Catches*:

I. Locality, date and time of catch with notes on the habitat.

II. Colour notes with special reference to the colour of the back, sides, belly, tail, cheeks, fins.

III. Body form and other general features, such as condition of lips, barbels, etc.

IV. Body proportions and weight:
Total length, Length without tail fin, Length of head, Depth, Girth.

V. Scale count:
Along lateral line, Above lateral line to beginning of dorsal fin, Below lateral line to beginning of pelvic fin.

VI. Sex; Condition of gonads: immature, fairly mature, full or spent.

VII. Food:
Gut-contents, items and their approximate proportions, such as 'insects 60%, molluscs 25%, aquatic plants 10%, indistinguishable, digested matter 5%'.

BIONOMICS.

13. *Food and feeding habits.*—The Mahseer is noted to be an intermittent feeder. Green filamentous algae and other water plants, slimy matter encrusting rocks, insect larvae, etc. have been recorded from the stomach-contents of the Putitor Mahseer. Thomas, discussing the food of the Mahseer, observes:—

'Aquatic weeds of all sorts, some taken intentionally, some when grabbing at the insects that live on them; seeds of the *Vateria indica* or Dhup of the West Coast, which are about the size of a pigeon's egg; the seeds of many other trees also which hang over the river where it is forest-clad; bamboo seeds; rice thrown in by man; and unhusked rice, or paddy as it is washed from the fields; crabs . . ., small fish, earthworms, water beetles, grasshoppers, small flies of sorts, water or stone crickets, shrimps, and molluscs or fresh-water snails are also found there, the latter shell and all, and smashed to pieces like the crabs.

'Of all this category the easiest food for the fisherman to present in a natural form is a small fish, or imitation fish.

'It will also be observed that the food taken on the surface of the water is little in comparison with that taken under it, and at the very bottom. The fish, beetles, crickets, shrimps are all found well under water; the crabs, worms, molluscs, quite at the bottom; and from the proportionate quantity found in them, the crabs, molluscs and fish seem to be their favourite food.

'This is what Paley woud call "internal evidence". But we have also external evidence to the same effect . . . The four fine feelers hanging down, two on each side of the mouth, which give him the scientific name of *Barbus* or bearded (from the Latin *barba*, a beard), are indications of a bottom feeder.

'The upper lip is capable of being extended beyond the lower lip, and brought down to the same level, so as to form a cup on

the bottom of the stream, and cover any small body, such for instance as the aforesaid molluscs detached from their hold by the upper lip, and being washed rolling down the bottom of the stream. The molluscs being thus detached and covered, are readily drawn up into the mouth by suction.' The suctorial mouth may also be used for adhesive purposes against the swift currents.

Whereas in the younger stages Mahseers feed on algae, insects, small fish, etc., middle sized specimens and older ones prefer crabs, molluscs and other hard objects which can be easily tackled by the crushing and grinding pharyngeal teeth, often prized as trophies by the angler, especially as these provide fairly reliable evidence of the size of the specimen caught. These teeth are borne on the pharyngeal bone, which is the well developed fifth gill arch. As the pharyngeal teeth lie in the throat of the fish they are not used in catching or holding the prey, but are employed for tearing and masticating purposes. As the fish grows the teeth are shed individually as they become worn, and replaced by fresh teeth that may be found growing in the adjoining mucous membrane.

Examination of the gut-contents of a large number of specimens will reveal the feeding habits of the fish in different waters. The digestive tract of the fish enlarges into an elongated thin-walled bag-like stomach which leads into a long narrow tubular intestine coiled into several loops and opening out at the anus. The liver and other digestive glands are associated with the tract. For purposes of food analysis the gut may be severed at the throat and at the anus, and after making a tiny incision on the stomach the whole, with the contents intact, may be preserved in 5% formalin and sent to the Society.

14. *Migration and spawning*.—During the floods the Mahseer ascends considerable heights to gain the upper reaches of the river, travelling long distances for fresh feeding grounds, and for the purpose of spawning. There they linger till the diminishing stream warns them to be moving downwards. There they lay their eggs in sheltered rock pools, not in the manner of the salmon, all at one time, but a batch of eggs at a time, repeating the process several times in a season. The Putitor Mahseer is said to spawn three times in a year. In the Punjab the three spawning seasons are (i) January and February, (ii) May and June (snow melts), and (iii) July to September (monsoon months).

Other Himalayan Mahseers.—The following key of Hora will be helpful to distinguish specimens over 9 inches of the various Mahseers of established status:

I. Labial groove interrupted in the middle; lips comparatively thin and never hypertrophied; cheeks covered with tubercles.

Barbus (Lissochilus) hexagonolepis McClelland. The Katli of the Nepalese and Bokar of the Assamese. The Chocolate, Olive, Black or Red Mahseer of Burma.

II. Labial groove continuous; lips thick and well formed, sometimes produced into adipose flaps; cheeks smooth.

A. Length of head considerably greater than depth of body.
Barbus (Tor) putitora (Hamilton).

The Golden or the Common Himalayan Mahseer including Greyhound and Thick-lipped varieties.

B. Length of the head considerably shorter than or more or less equal to depth of body.

1. Length of head considerably shorter than depth of body.
Barbus (Tor) tor (Hamilton).
The Deep-bodied Mahseer.

2. Length of head more or less equal to depth of body.
Barbus (Tor) mosal (Hamilton).
The Copper Mahseer.

15. *Size and distribution of the Mahseers.*—The Putitor Mahseer has been recorded by Hamilton to grow up to 9 feet. It occurs all along the Himalayas and probably extends to China. The Lissochilus Mahseer is said to grow over 2 feet in length (a 21-lb. *Katli* has been reported by Holt, 1940). It is the commonest large-scaled barbel of Assam and of the Eastern Himalayas. The Tor Mahseer grows to about 4 feet. It seems to be widely distributed along the foot hills of the Himalayas. It also occurs in the rivers of Assam and the Central Provinces. The Mosal Mahseer may attain a length of 5 feet and appears to be more common in Burma than in the Himalayan streams.

16. *The Black Mahseer.*—The Black Mahseer is a case of *melanism* or unusually dense pigmentation. It cannot be regarded as a distinct variety since melanic specimens belonging to different species have been described or figured as Black Mahseer. Several cases of melanism in diverse types of fishes are on record and it is believed to be due to genetic or pathogenical causes. How far environmental factors such as the influences of light, temperature, climate, food, etc. are responsible for melanism is yet to be determined.

To those interested in this subject, and who wish to study it further, I can do no better than introduce them to Shaw and Shebbeare's 'The Fishes of Northern Bengal', and Dr. Sunder Lal Hora's series of articles on 'The Game Fishes of India' appearing in *The Journal of the Bombay Natural History Society* (from Volume xxxix, part II of 15 April 1937 onwards). The first is already available in book form excellently arranged with drawings and photographs of most of the fishes to be found in India, with clear and simple notes, and is easy to follow. Dr. Hora needs no introduction. He is the leading authority on Fish in India, and his articles are of immense value to all lovers of the sport. I look forward to the day when this series will have been completed and published in book form—the fishes illustrated in colour—to take its place by those excellent volumes published by the Society, *The Game Birds of India*, etc.

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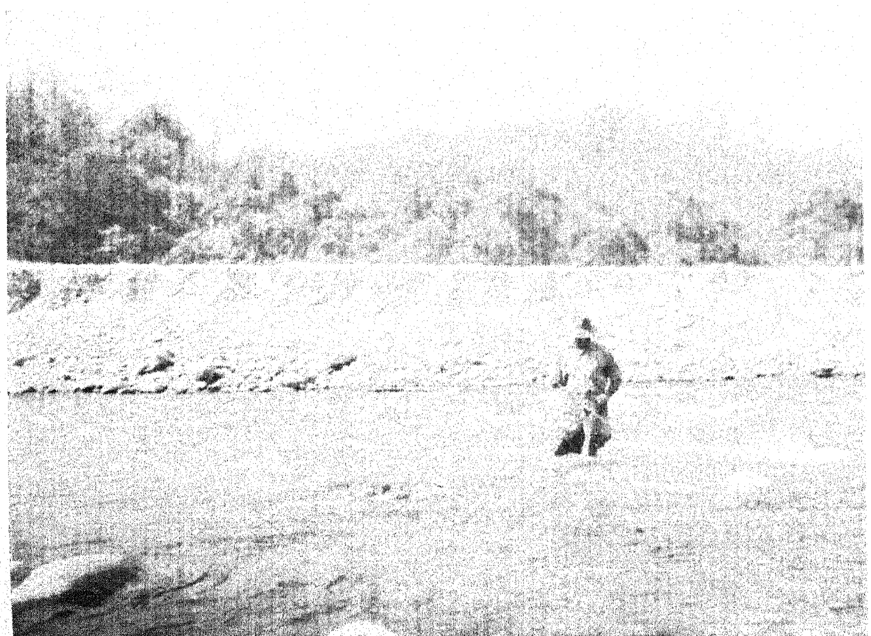
The young novice aged 5½ years: my son with his first Mahseer 3½ lbs.



"White Feather" of water just above the figure.

CHAPTER III

The Scientific Aspects of Angling.

Scientific explanations of the functions of the lateral line (1). Hearing (2). The eye and vision (3). The chemical senses of smell and taste (4). These views compared (5). How the Mahseer fits these theories (6).

Fishing, like all forms of sport, calls for an understanding of our quarry, and a few general principles should first be considered before hastening to the water's edge to wet a line. Judging from the casual conversations in a club or a bar, or from articles written to the press, there appear to be a great many anglers who know little or nothing about the senses of fish. It is for this reasón that I think a short chapter on the senses of fishes will be found instructive and interesting; as quite apart from the method of approach while fishing, these senses, if understood, will help the angler in adapting his lure with better understanding, and give him better results.

The application of sight and hearing, or taste and smell, as we know them, are too readily applied to a fish, but the environments and elements affecting or governing these are not sufficiently borne in mind. The angler will pay great attention to the colour of his fly and its resemblance to the natural insect, but give little or no attention to the structure of the lure, wherein probably lies more than half the secret of success or failure. We will see later on in this chapter that the sight of fish is a secondary sense to feel, much as a tiger's scent is secondary to his sight and hearing.

Science has proved that the senses of a fish have developed on very different lines to ours, and that these must be adapted to the greater density of water might well be imagined. Water being incompressible, any displacement sets up pressure waves, which are quickly registered and detected by specially adapted organs provided in fish. These are of a highly sensitive nature and contained in the Lateral Line. How far the detection is minimised, if at all, in the disturbed and distorted waters of a rapid or fall, or how far such vibrations travel up-stream, is not clear; but provision must surely be made in the nervous system of a fish for differentiating between the natural and unnatural, much as the keen ears of a sambar do between the rustling leaves in the wind and those disturbed by a footfall.

How vibrations are transmitted or interchanged by the different elements I am not in a position to say; but a fire by the side of water certainly registers some form of signal to fish. I have seen this on the Surju, in Kumaon, when a pyre is lit, and where, I regret to say, mahseer are master scavengers. At Rewa, also, I have seen fish collect to be fed near a temple when a huge bell is rung. If you keep in mind the 'touchiness' of a fish, and adapt your methods accordingly, you will nót be disappointed.

Neither Thomas, Lacey, nor Skene Dhu, deal with the functions of the Lateral Line (which to me is the most important factor

governing all approaches to angling), in fact most of the views expressed are misleading in their interpretation of the senses of fish.

I am fortunate in having with me J. R. Norman's excellent book *The History of Fishes* 1931, and J. E. Nielsen's interesting article *Angling has Scientific Angles* published in the 'Scientific American' in July 1934, Vol. 151, No. 1.

Norman's work is a highly comprehensive and technical survey of all fish, whereas Nielsen's article has been written in more popular language for the angler.

With the aid of these I will now deal with the senses of fish in order of importance, as applied to angling.

1. *Scientific explanations of the lateral line.*

'The lateral line consists of a series of perforated scales running along each flank in most of the bony fishes. It consists of a canal or tube sunk into the skin and opening to the exterior by a series of pores. There is a group of sensory cells beneath each pore, and these serve to give the fish impressions of minute differences in the pressure of the currents of water.' (**3**. p. 43).

'The sense organs of the lateral line are served by fine nerves arising from a special branch of the vagus (tenth) cranial nerve running parallel to the line itself, and conveying the sensory impressions to the brain. The lateral line system has generally been regarded as the seat of a sense akin to "feeling", but it would perhaps be more accurate to describe this sense as combining the qualities of hearing and touch.' (**1**. pp. 200-202).

'Hearing and feeling are closely related senses, and in the case of fish there is no definite border line between the two. In addition to periodic sound waves, there are other waves—non-periodic pressure waves, which humans cannot perceive. A worm wriggling in the water, or an insect falling on the surface will set up waves of pressure in the water around them: these will instantly be noticed by the fish. For this purpose it has an extremely suitable organ the "lateral line". As we ourselves do not possess this organ, it is difficult for us to imagine how its sensations feel, but there is no question that its sensitiveness is far superior to that of fish vision. This fact is affirmed by the strong lateral nerve system connected to it. The best analogy we can give is that of a blind man with his stick, but the fish has long "sticks" in all directions, and every stick has a sensitivity equal to the tip of your tongue—every stick is in fact a "teletoucher". Most fishermen do not pay much attention to this organ, but it is nevertheless the organ which causes more bad luck among fishermen than all the other senses combined. With this organ, fish are able to feel the least "touchiness" in the surrounding medium.' (**2**. pp. 20-21).

In supporting the theory of the sensitiveness of the lateral line, and the acute feeling of a fish of anything foreign in the immediate medium surrounding it, it occurs to me that the Tank Angler may ask 'But what of paste bait or dead worms threaded on a hook—how is their presence registered to a fish?'

Here let me put forward my own theory, giving as an example the Vulture.

A few years ago, a long series of letters appeared in the press, on how vultures make contact with carrion. A great deal of controversy took place, and various views were put forward, but in the end it was generally accepted that sight was the only means of the vulture finding food. This was systematically led up to: flies attracting birds, and birds other scavengers, such as crows and kites, and these in turn attracting nearby vultures and so on.

This is exactly how I reason fish to react to ground bait in a tank. Small fish and turtles attract the larger fish near at hand, these in turn attract others within the registering range of themselves and so on until the fancied Rohu and Cutla arrives within the range of its chemical senses, and is so directed to the hook of paste or worms, the distance of diffusion depending on the flavour or smell of the bait used.

2. *Hearing.*

'A study of the development of the inner ear shows that this must have been at one time one of the sense organs of the lateral line, before becoming specially enlarged and modified in order to adapt it to the perception of delicate sound vibrations, and to the maintenance of equilibrium.' (**1.** p. 201).

'In fishermen the ear is divided into three parts. The external, the middle, and the internal ear or the labyrinth. Fish possess only this latter part. The reason for this difference is clear. The function of the ear is to collect vibrations of various frequencies. In the case of humans the ear is surrounded by air, and the funnel-shaped external organ is an efficient device for collecting these vibrations, because the medium in which they are set up has a density of only one thousand of that of which the ear is built. Fish on the other hand are surrounded by a medium having the same density as that of which they are built, and their whole body partakes of the vibrations set up in this medium. The labyrinth is the only organ required to transfer the physical vibrations to the nervous system. As the receiving nerve centres of a fish are built much the same as ours, we may assume that its sense of hearing is similar to ours, possibly better, on account of the high density of water with which the nerve centres are in direct communication.' (**2.** pp. 20-21).

3. *The Eye and vision.*

'In its general form the eye of a fish is not unlike our own, but it is necessarily somewhat modified for vision under water. . . . The lens of a land vertebrate is somewhat flat and convex on both sides, but in the fish it is a globular body, the extreme convexity being a necessity under water because the substance of the lens is not very much denser than the fluid medium in which the fish lives.' (**1.** p. 185).

'In the human eye, light rays enter the first lens through the cornea, which contains a transparent fluid of refractive index the same as water, namely 1.33. Next it passes through the pupil to the second lens, which has a refractive index, of about 1.141. From

this it proceeds through almost pure water to the retina, where the image is picked up by the optic nerve. This device of sight is highly efficient in air, which has a refractive index of 1.00, but when immersed in water, which has a refractive index of 1.33 it is very inefficient. The reason for this is that, as is shown by the principle of optics, light rays which enter the eye will then not be refracted by the first lens, but will go through to the second lens in a straight line, and this will have a relative refractive index of only $1.41 \div 1.33$ or 1.06, which is too low to make possible a sharp image on the retina. In order to improve upon the low refractive power of the eye of a fish, nature has increased the curvature of its only active lens to the maximum possible, which is the sphere. As we know from optics, the disadvantage of a spherical lens is that only the very central rays will a give a tolerably clear image. It exhibits marked spherical aberration. This, combined with the low refractive index, makes fish very near-sighted animals. They are able to sense changes in light intensity . . . . We may also see that a flash reflected from a shining spoon or wobbler may allure with the same power as the reflection from the side of a fish.' (**2.** pp. 20-21).

4. *The Chemical senses, smell and taste.*

'. . . which are separated in fishermen, are combined into one by fish. As the nature of smell is to perceive odorous matter highly diffused in air, and as fish are not surrounded by air, there can be no sensation of smell as it is known in fishermen. There may, however, be a better developed sense of taste, judging from the abundant distribution of taste buttons in and around the mouth, and on the side of the head. It is possible that fish can taste matter highly diffused in water as easily as we can smell it in air. Taste and smell are quite different sensations. It is only occasionally that an agreeable smell arouses our desire to eat. Some fine perfumes, for example, have a definitely disgusting taste. The practice of some fishermen, of perfuming the bait is useless and unscientific'. (**2.** pp. 20-21).

In relation to the theory set out on the chemical senses, as interpreted by Nielsen, Norman dealing with the olfactory organs states :—

'. . . the sense of smell resides in the nasal or olfactory organs, but, unlike the higher vertebrates, the nostrils or nasal openings are never (or scarcely ever) used for breathing purposes. Typically, each nasal organ consists of a somewhat deep pit lined with special sensitive tissue, and in order to provide the maximum of sensitive surface, the lining is generally puckered up into a series of ridges which may be parallel to each other, or arranged in radiating fashion like a rosette . . . . In bony fishes both nasal pits are divided into two separate portions, each with its own opening to the exterior. The position of the nostrils varies considerably in different fishes. In some the anterior nostril is widely separated from the posterior, in others the two are almost in contact. Occasionally, as in the Cichlids (*Cichlidae*) and in certian Wrasses (*Labridae*), the nasal organs each have only a single external orifice. In some of the Eels (Apodes) the anterior nostril is situated on the upper lip (labial position) and in many of the globe-fishes (*Tetrodontidae*) there are no actual apertures but a pair of solid nasal tenticles . . . . There

can be little doubt that the sense of smell in fishes is relatively acute, as has been proved by numerous experiments. The large nasal organs of sharks are said to enable them to "Scent actively as well as passively", and it is well known that the smell of flesh or blood or of a decaying carcase will attract them to it from some distance away. The Caribe or Piraya (*Serrasalmus*), the ferocious Characin-fish of the rivers of South America (cf. p. 130) is irresistibly attracted by the smell of blood, and woe betide the animal unfortunate enough to be bitten by one of these pests, for hundreds more will rush to the spot with incredible rapidity. As long ago as 1653 Izaak Walton wrote the following in his *Compleat Angler* with reference to the sense of smell of fishes. "And now I shall tell you that which may be called a secret. I have been a-fishing with old Oliver Henly, now with God, a noted fisher for trout and salmon; and have observed that he would usually take three or four worms out of his bag, and put them into a little box in his pocket, where he would usually let them continue half an hour or more before he would bait his hook with them. I have asked him his reason and he has replied: 'He did but pick the best out to be in readiness against he baited his hook the next time' but he has been observed, both by others and myself to catch more fish than I, or any other body that has ever gone a-fishing with him, could do, and especially salmons. And I have been told lately, by one of his most intimate and secret friends, that the box in which he put these worms was anointed with a drop, or two or three, of the oil of Ivy-berries, made by expression or infusion; and told that by the worms remaining in the box an hour, or like time, they had incorporated a kind of smell that was irresistibly attractive enough to force any fish within the smell of them to bite." Mention may be made of a number of careful experiments conducted by Mr. Gregg Wilson at Plymouth at the end of the last century, with a view to ascertaining the respective parts played by the sense of smell, sight, etc., in obtaining food. He concluded that "fish that are not *very hungry* habitually smell food before tasting it", but, when really ravenous, Pollack would bolt clams that had been saturated with alcohol, turpentine, chloroform and other unpleasant substances without any hesitation. He also states that in many cases the fish actually search for the meal by sight alone, and then test the quality of what they have found by smelling it. Some blind specimens of Pollack, however, were able to find their food by smell alone, and there are doubtless other forms which do this habitually, especially those dwelling in muddy or foul water, where the eyes would be of little use. The Cod (*Gadus*) is generally believed to feed more at night than in the day-time, and may rely largely on its olfactory sense. Mr. Gregg Wilson has shown that the Dab (*Limanda*) is normally a sight feeder, but under experimental conditions, if a number of worms were placed in a small wooden box with minute apertures to allow the water to pass in and out, considerable excitement was immediately produced, and the fish hunted eagerly in every direction.

'When water in which many worms had lain for some time was simply poured into the tank through a tube that had been in position for several days, and by a person who was out of sight of the dabs, the result was most marked . . . . Yet there was nothing visible to

stimulate the quest. From the above and other sources of evidence it may be concluded that the sense of smell plays a fairly important part in the daily life of a fish, and although as a general rule this is not the only sense upon which it relies to obtain a meal, if the eyes or ears should in any way fail to function it could probably be induced to search for its food by smell alone.' (**1.** p. 182-185).

From the text of these extracts, it will be seen that agreement in all the views quoted is evident, except in the chemical senses of smell and taste, which is by no means conclusive.

From the anglers' point of view there is little to distract us from the theory or methods to be applied or followed, as both these senses are so closely related, that even were we to follow one theory or the other in principle, we would still find ourselves proceeding on much the same lines. For taste or smell acting as a secondary sense to that of feel, or the functions of the lateral line, would be applied by the fish to our lure in a similar manner.

5. *These views compared.*

It is interesting, however, to compare how these two authorities approach this subject, and from a purely practical standpoint I think one explains the other.

J. R. Norman dealing with the functions of the nose says:

'In order to provide the maximum of sensitive surface, the lining is generally puckered up into a series of ridges, which may be parallel to each other or arranged in radiating fashion, like a rosette.'

He goes on to say that in some fishes the nostril actually communicates with the roof of the mouth. Nielsen on the other hand states:

'Smell and taste, which are separated in fishermen, are combined into one by fish. As the nature of smell is to perceive odorous matter diffused in air, and as fish are not surrounded by air, there can be no sensation of smell as it is known by fishermen . . . . It is possible that fish can taste matter highly diffused in water, as easily as we smell it in air.'

These would indicate from our point of view that whichever is correct the functions of the nose or taste 'buds' or 'buttons', in relation to finding smelly or scented bait, are so closely related that no difference arises, nor does it call for any change of method for one or the other.

The tank angler who applies high or smelly cheese to his bait is convinced that it is smell that attracts the fish, whereas if it were to be analysed it might quite easily prove to be taste, and so also in the experiments as quoted by Norman in connection with blood, rotten meat, and ivy berries. It is too deep a subject for this little book, and is a monopoly of the 'pundits' of Science.

I have taken the liberty to quote freely from these two authorities (Norman and Nielsen), so as not to leave any doubt in the reader's mind about the authenticity of the various functions of the fish's senses, and to make available for the average angler facts about fish that would not ordinarily come his way.

6. *How the Mahseer fits these theories.*

I will conclude by summarising these senses as applied to the mahseer, to which this book is chiefly devoted.

(1) *Lateral line.* The mahseer has larger scales than most fish, with a bold and well defined lateral line, so that it is reasonable to presume that it is well developed, and the functions attributed to it are keen, and that it is probably the chief sense by which this fish is attracted to a lure.

(2) *Hearing.* This is closely related to the lateral line, and its functions are probably absorbed into it, having a specific purpose, of separating certain vibrations. Its sensitiveness is probably as keen as the human ear.

(3) *The Eye and vision.* The eye of the mahseer is bold and large, but his choice for rapids and broken water, especially when feeding, would indicate that his vision must be limited considerably and subordinated to the more highly developed sense of feel.

'. . . experiments have shown that the sense of sight probably plays the most important part in the search for food, but at the same time, this is much more limited than that of a land vertebrate; and, owing to the general haziness of the water, due to the presence of organisms and other matters suspended therein, objects must appear of somewhat uncertain outline. The extreme convexity of the lens of the eye points to the fact, that a fish is near-sighted, and even in the clearest water it is doubtful whether the range of vision exceeds about 12 yards, if as far as this. It is not unlikely that the fish really notices movements or changes in outline rather than in actual objects.' (1. p. 190).

(4) *The Chemical senses.* I have already dealt with these, so far as they concern angling.

List of References.

(1) J. R. Norman, F.L.S., F.Z.S., 'A History of Fishes' 1931. (Assistant Keeper, Department of Zoology (Fishes), British Museum, London.)

(2) J. E. Nielsen, B.Sc. 'Angling has Scientific Angles'. From the *Scientific American* July 1934, vol. 151.

(3) Sir Reginald Spence, *Kt.*, M.L.C., F.Z.S. (former *Hon. Secretary, B.N.H.S.*), and S. H. Prater, M.L.C., C.M.Z.S. (Curator of the *B.N.H.S.*). 'Game Fishes of Bombay, The Deccan and the Neighbouring Districts of the Bombay Presidency'. *Journal, Bomb. Nat. Hist. Society*, vol. xxxvi, pp. 29-66. (With 19 plates).

CHAPTER IV

Elementary Notes for the Novice.

'Have you gazed on naked grandeur where there's nothing else to gaze on,
Set pieces and drop-curtain scenes galore,
Big mountains heaved to heaven, which the blinding sunsets blazon,
Black canyons where the rapids rip and roar?
Have you swept the visioned valley with the green stream streaking through,
Searched the vastness for a something you have lost?
Have you strung your soul to silence? Then for God's sake go and do it;
Hear the challenge, learn the leason, pay the cost.'

R. S.

Mention of Mahseer and its gameness (1). Tackle (2). The reel (3). The rod (4). The line (5). Traces (6). Gut substitute (7). Wire (8). Swivels (9). Lures (10). Plug baits (11). Dead or natural bait mounts (12). Leads (13). Hooks (14). Casting fly with spoon (15). Attaching spoon to trace (16). Casting the spoon (17). Stationary drum reels and outfits (18). Revolving drum reels and outfits (19). Where to look for Mahseer (20). Gram Fishing (21). How to play a fish (22). The best season (23). Kit (24).

1. *Mention of the Mahseer and its Gameness.*—We will set aside all comparisons of the mahseer's gameness as compared with the salmon, sea trout, or any other 'game fish'. In India, anyway, pride of place goes to this fish; be it on a light fly rod or a strong 12-foot spinning rod, it affords the chief sport for the angler in India. I estimate that with reasonably light tackle (that used for trout or salmon) the mahseer gives fight at approximately 2 to 3 minutes per pound of weight, and this, should the reader wish to make comparisons, will be a rough guide. I have killed a 75-pounder in 40 minutes, and it has taken me one hour and twenty minutes to kill one of 23 pounds. But these are isolated cases, and for an average reckoning with the fly rod, I think my estimate of 2 to 3 minutes per pound of weight will not be found far wrong.

The mahseer is to be found throughout India and Burma, where rivers are suitable or large lakes fit his environments. Rivers must rise in the hills, be perennial, with rocks, rapids, and deep pools, for this fish to thrive. Some of the canals in the Punjab and U.P. also hold this warrior, especially if there are falls and fish ladders. An interesting thing about the mahseer is that his fin area is greater than the total superficial area of the rest of his body. This makes him a strong and powerful fish, able to live in the big and heavy waters of Indian rivers, in fact no water is too strong to hold him. My own experience with both fly rod and heavy spinning rod has convinced me that for fly spoon work, 150 yards of line is necessary, and for heavy work 300 yards. Time and time again I have needed the extra 50 and 100 yards, and then had to follow down stream, sometimes as much as 300 yards to kill my fish.

Anyone who has caught mahseer knows what the first rush means, but by the novice or beginner this cannot be fully appreciated until experienced. I have heard it aptly described as terrifying, and it can be. Your arms are nearly torn out from their sockets, and all the skill and experience you may have will be needed to keep up the point of your rod. I refer to heavy fish in heavy water. On the fly rod the same rush is made when the bait is taken, and you are left guessing and estimating the size of the fish, but you will often be disappointed when at the end of the fight you see a game little chap of 3 pounds in the landing net, that you estimated at ten. This has been my experience of the mahseer, I hope it will be yours.

2. *Tackle.*—I will try to assume for the novice exactly how I felt when a beginner, and pose myself as the instructor with some 22 years experience. We will start with a well-equipped library of books and catalogues, a small banking account with both 'thrift' and 'extravagance' as the brother pupils, and with my own tackle outfit on view. For the beginner I think that the light fishing will hold out far more attraction and bring earlier success than the more skilful and laborious methods required for the heavy fish. For the two methods are as unlike as salmon and trout fishing, and can be compared to the 'Scatter Gun' and rifle as to results. The heavy rod in six or seven hours fishing may only produce three or four runs, and quite often not one, whereas the fly rod will generally produce some fish, if not small mahseer then the sporting little *Barilius bola,* commonly called Indian Trout, or one of his many cousins. I will mention in order of importance what I consider the essentials, and with them my suggestions.

3. *The Reel.*—This is the most expensive item, but also the most important, as cheap reels will be a constant worry, with springs snapping, bearings seizing, plates jamming, etc. and lots of fish and tackle being lost. A good reel will cost, upwards, from Rs. 40 to Rs. 140. That is one with a good foundation, only to be found in the higher priced reels. Bearings of gun metal or the other improved alloys, the spindle firmly set, the ratchet well fixed, and the check spring strong in playing out, but free or just engaging when winding in. If you stipulate these essentials to your tackle dealer, you will have got as near the perfect reel as possible. I do not stress a well fitting drum, or the avoidance of prominent nuts, handles, levers, etc., as the manufacturers know well these are to be avoided for fly reels, as they foul the line and breakages occur. The check should be adjustable, as it can then serve for both light and medium work, but it must be strong enough to hook the fish without any pressure by hand. You cannot apply hand pressure on the line for mahseer, as he takes with such a rush that you will cut or burn your hand or fingers if you try. The size should be near the correct weight for your rod, but it must be large enough to take 150 yards of line and backing, unless of course you are only likely to fish in very small streams.

I am trying here to fit one reel to the universal use of Indian rivers, keeping 'thrift' ideas in mind. I will not mention any special makes of reels, as there are dozens on the market today, and it is your business to find the most suitable one fitting these

points, at the cheapest price, bearing in mind that cheapness does not always spell economy.

I am exclusively equipped with Hardy's reels, and use a Hardy's Silex $3\frac{1}{2}$ inch, but even so I have to take the reel down after each run, to tighten up the four screws fixing the ratchet to the drum. I understand however, that this has been partly overcome in the more recent and improved Silex. Mine are eleven years old!!

4 *The Rod*.—This is rather more difficult to advise on as rods are made in degrees of pliability, and are today reduced to a mathematical fine art though, I am sorry to say, nothing has been put on the market, to my knowledge, to fit the Indian fishing. Dry fly rods are generally the most suitable, as they are stronger built, and stand up to fly spoon work better than wet fly rods. I fancy split cane, but green-heart and steel rods are also good. It has to be borne in mind, however, that in some of the very hot, moist valleys, in parts of this vast country, split cane may not be suitable. The universal fly spoon rod should be between nine and ten feet long, in two or three pieces, with a spare top, and with agate or chromium steel rings at the butt and end, with good strong steel intermediate rings. (Agate rings should be frequently examined under a magnifying glass, as they are apt to crack.) It must be capable of throwing a fly spoon up to one inch (2 drachms in weight) and *most important of all,* be capable of recovering the spoon in fast heavy water, as this is when a rod is most severely tested. It must also be light and pliable, so as to give play to a fish of a pound weight, and be capable of standing up to a fish of 20 pounds in exceptional cases. *Do not touch steel centres*, as they are not suited to the Indian climate. A good rod will cost up to Rs. 200, but there are lots partly fitting these requirements for Rs. 40 or Rs. 50 in green-heart, steel and cane, so that your choice must be governed by the price you are prepared to pay. I use a 'Perfection' two piece double built split cane rod, 10 feet in length built by Hardy's, but it is too light for casting anything over $\frac{1}{2}$ a drachm in weight. For the heavy fishing a 9 feet 6 inch to 10 feet 6 inch spinning rod, will fit the requirements of all water, and as long as agate and porcelain rings are fitted and the rod has a certain amount of give down to the handle, it will cast a large spoon with a heavy weight, as well as spoons of $1\frac{1}{2}$ to 2 inches and will stand up to any size of fish. Even shorter rods of 7 ft. with the American casting-reels are very popular, and large fish have been taken. The more pliable the rod the better it is for striking a fish.

I use a 9 ft. bamboo rod built by Verona to my specifications, and is all that is desired, and well within the price of most anglers, Rs. 30. I have besides an 11 ft. split cane spinning rod by Hardy, for very big water where fish run over 50 and 60 pounds. The range in price for these two rods is Rs. 30 to Rs. 250.

5. *The Line*.—Braided silk dressed lines are the best value, and last indefinitely if cared for and dried daily after use. Water-proof and enamelled lines do not do well in this country, they are besides expensive and a constant source of worry and trouble, getting tacky and brittle in our varied climate. Tapered lines are attractive

to use, but with a fly spoon sufficient weight is provided for long casts, so the ordinary graded line is good enough. 'Lignum Vitae' or 'Non Pareil' is what I use with a flax braided line or 'cutty-hunk' as backing. Grade 'H' with 14 pounds breaking strain for fly spoon work, and grade 'E' or 'F' for the heavy fish with a breaking strain of 24 and 30 pounds, respectively. Backing should be slightly stronger than the dressed line, so as to provide a margin of safety should a break occur.

6. *Traces.*—Natural Gut is the most popular, and what I personally favour for fly spoon work, but it is expensive and difficult to come by these days. 'Medium Trout' to 'Sea Trout' sizes are strong enough for fly spoon. A good length of trace is 5 to 6 ft.

7. *Gut Substitute* has its supporters, and is both strong and convenient to tie into casts or traces, but knots must be very carefully tied as they have a tendency to slip. Durofix applied to the knot holds well, also to prevent the knot drawing or slipping, lay a piece of thin soft copper wire alongside one of the strands of gut substitute, and tie it in with the knot.

8. *Wire.*—Killin and other similar makes of wire make up into excellent traces and leave nothing to be desired. It is made in 5 sizes 1x, 2x, fine, medium, and strong, of 8, 12, 15, 20, and 25 pounds breaking strain. It is almost invisible in water, when new.

Alasticum is a new elastic steel wire, made in much finer grades and with a breaking strain down to 5 pounds, which is as fine as hair and should be excellent for light work. Avoid gimp or twisted wire, as it sets up friction in water, and is liable to kink.

9. *Swivels.*—Use the finest sizes, Nos. 8 to 10. Three to a trace of 1¼ yds. in length in any grade of wire for heavy fishing. Learn to tie your own traces as it saves both expense and time, wire can be changed on to the same swivels in a few moments. Knots for tying gut traces and twisting wire will be discussed elsewhere in this book under 'Tackle'.

10. *Lures.*—Spoons vary in shape, size and colour, almost as much as flies, so that one's fancy must be largely a matter of local choice as certain spoons suit certain localities. Remember that it does not follow that spoons of small size will only catch small fish, and large spoons large fish. I have caught on a ¾ inch fly spoon scores of fish over 20 pounds, and one of 29½ pounds, likewise on a 4-inch spoon fish of only a pound and a half. Shape and spin more than the size, is the deciding factor. I myself fancy as a general favourite a long narrow spoon shallow in depth, with deep scales cut into the convex side for the larger sizes as on the Myitkyina spoon, and just a plain surface for the smaller sizes in fly spoons; but remember what I have written in Chapter V about spoons in general.

Hardy makes an excellent semi-hogbacked spoon in three sizes, and for neatness and finish these cannot be surpassed. It is an excellent example to follow if you mount your own spoons.

For the many other lures such as Halcyon spinners, Phantoms, Pennell, Devons, fly minnows and insects, etc., all take well and I recommend a variety to be carried and tried, if spoon fails. These patent spinners are beautifully turned out and come through the

water in a most natural fashion, and do not tax a rod nearly so much as a spoon in heavy water, being much easier to recover; this also applies to the larger sizes for heavy fish.

11. *Plug Baits.*—In recent years these have come very much into prominence and are now more popular than spoon in a number of localities. The American makes are the most favoured, and are made in one or two pieces. The one-piece is favoured for heavy water, and the jointed two-piece for slower runs. They are beautifully turned out and are very natural in water but the trebles must be changed, they are only made in the larger sizes for big work, and special mahseer hooks must be fitted.

One great feature in favour of plug bait is that they float, and do not consequently get hung up nearly so often as spoon in shallow bouldery rapids if a bad cast is made. They also provide a good substitute for dead bait when not procurable. The shield set on in front and below the head takes a remarkable hold of the water, and keeps the bait well under while fishing. The colours and types should be suited to local conditions.

12. *Dead or Natural Bait Mounts.*—Crocodile and Archer spinners are the most popular mounts for dead bait, but there are also many others, the leaded variety are good if spinning is being done in very big water. The best of all mounts however, and the least visible, is the threaded wire two-piece mount as described by me elsewhere in this book.

13. *Leads.*—These are made in a number of shapes and sizes, but I do not recommend any permanently fixed lead on a line, as more fish are lost in this way than any other. The type I favour is the barrel shape, with a hole through the length, so that a strong piece of silk can be used to fasten it to the swivel of the trace, which would snap if it was fouled in a snag. The spiral or other types of lead may be used where rivers are not full of large boulders and snags. They are easy to attach, and do not foul the line or trace.

The bullet shaped 'Hillman' lead, is very quickly attached to the eye of a swivel, and weights can be speedily changed to suit varying water. This is especially useful when fishing from a boat or coracle, and changes of lead have to be quickly effected.

14. *Hooks.*—Only use the best hooks on whichever line you may have, as the crushing power of the mahseer is phenomenal. I have avoided any mention of fly or fishing with fly; it is far easier for the novice to learn how to cast a small spoon than a fly, besides which I am anxious to get him into a fish as early as possible, and the chances for this are far greater with spoon. There are dozens of good books on fly fishing, so that any mention here would be superfluous.

15. *Casting with Fly Spoon.*—We will assume that you have assembled your rod correctly, reel put on with right hand wind (an orderly or servant invariably puts it on the wrong way), the joint of the rod well home, and the line threaded through all rings (an attendant will often miss one out), the trace correctly tied to the line. Remember a knot is the weakest part of the line. A loop made at the end of a line, and passed through the swivel and over the spoon and trace, then pulled tight, is the surest and

strongest and what I use for both light and heavy fishing. The figure of eight knot does just as well but is not as strong.

16. *Attaching the Spoon to trace.*—If you use gut the same attachment as I recommend for attaching the trace to the line will do. Put the loop through the eye of the swivel on the spoon, then over the spoon and draw tight, this gives you a double gut lead for a couple of inches and stands up to the wear and strain of both the fish's lips and the spoon spinning. *Avoid above all things* attaching swivel to swivel, as all the advantage of fishing light is lost if you have a chain of swivels leading your spoon. I use the smallest of swivels, and if fishing with fine wire and fly spoon, attach a small swivel to the end of the trace, and a split ring on the fly spoon, the spoon is easily attached or changed, and for fly spoon work split rings can be used with safety if kept oiled and free from rust. If solid brazed rings are preferred a fine attachment link may be used.

17. *Casting the Spoon.*—If you have fished for salmon, use the fly spoon in the same manner as you do a fly, casting across and slightly below you, while feeling the spoon all the time, allow it to work across and below you until it has straightened out the line, then draw it up through the swirls and eddies formed on the edge of the fast water. But for the beginner, we must be more explicit, as the whole casting operation has first to be mastered.

Grip.—The grip with either hand is the same, find the point of balance on the handle, with the fingers around and the thumb above and along the grip raise the rod and take the point back until the rod has travelled as far as it will go, with the wrist bent, the elbow close into the side, and the hand in line with the shoulder, which will bring the hand with the thumb under and along the grip, and the fingers above and around it. This is at the peak of the backward movement of the cast; only practice will teach you the correct time to pause, before the forward movement is started, which is when the line has completed the arc and has straightened out behind you.

The forward movement is a combined harmonising of the wrist, arm, and shoulder, the arm carries the wrist forward in the direction of the cast, with the shoulder moving slightly forward, and the wrist straightening out as it moves forward, the weight of the rod is taken on the first finger, and the thumb free and just clear of the rod at the end of the cast. This roughly is the action, and must be the first stage of learning. The beginner finds the timing difficult, but once the correct pause is made, the rest follows.

There are other important points to be considered. Unlike the fly, the spoon grips the water, and the first and most important action before recovering, is to raise the point of the rod slightly, so as to bring the spoon to the surface before attempting to start the backward movement, which is a brisk recovery by the wrist, arm and shoulder, of the rod into the first position described, sending the spoon back and past you, more or less in the same line as the point of the rod, which should be held in a vertical plane to the water. When this has been mastered a longer line should be tried, but here the other hand will come into play, by drawing the line through the bottom ring while bringing the spoon to the surface,

just before the backward swing. This shortens the lead, and is released when the forward swing is half way through. Important things to remember are:—

(1) Never point the rod down stream, but keep it as near to right angles to your line as possible. This is what the rod is for, to take the sudden strain, and spring the whole action of the gear into operation, which hooks your fish and reduces the shock on all the units of the outfit, while keeping a steady pressure on the fish all the time. As an example: get an attendant to hold your rod, with it pointed at you, draw a few yards of line off the reel, then repeat the same thing with the rod at right angles, and see the difference in tension.

(2) Keep feeling the spoon from the time it touches the water, until you recover it again; you will miss fish if you do not.

(3) Keep feeling your line to see it has not fouled either around the tip of your rod, or around the reel or handle. The best fishermen experience this, especially if a wind is blowing.

(4) Recover the point of your rod as soon as you strike a fish, and keep it up, for slack line, even for the fraction of a second, will lose fish.

(5) Do not try to hurry your fish, or drag him into the net. Mahseer have very leathery mouths, and the hook is easily torn out. Remember my estimate of 2 to 3 minutes per pound weight.

(6) Keep your finger and hands clear of the line, or you will regret it. Strike the fish from the reel, and of all things avoid braking a fish in its first rush, or you will lose more than you catch.

(7) If wading or in water, do not move until after you have recovered line, and after the fish has made its first rush, then work your way out of the water and play him from below, so as not to disturb the water above.

(8) When landing a fish, bring it into the net, do not allow the attendant to bring the net to the fish, this generally ends in disaster; if you are fishing with more than one hook, try to shelve your fish, as quite often a fish is hooked outside the mouth by only one of the two trebles, and the net may get fastened to the loose hook, and you will lose your fish.

(9) Kill your fish if possible at once, but it does sometimes become necessary to keep them alive, if the weather is very hot and fish are taken early in the day, and you are moving camp. A cord passed through and around the gills and tied to a boat, will keep the fish alive and frisky. If you have a good day and have more fish than you require, the smaller ones can be put back into the river.

The nine points enumerated above, are general to all types of fishing and item (7) is general to Indian fishing, as few rivers in India can be commanded from either bank, and wading is necessary to get out to good water.

So far we have considered what is the common method of fishing, that with the fly rod, which will also serve us on 'home leave'. We will now consider the other point of view, and fit 'extravagance' ideas.

18. *Stationary drum reels and outfit.*—This is commonly and

better known as 'Wanless' or thread line tackle. To all who use it, it proves attractive and has the charm of being of the lightest material. A short casting rod of 5 to 7 ft., a highly mechanical reel, that has its mechanism revolving around the drum, with a multiple wind in, and a thread line with a breaking strain of from 9 or 10 pounds down to one pound. Once you have acquainted yourself thoroughly with the mechanism and working of the reel, the rest is simple, as you can make a cast in any manner you wish, flick it out, swing or cast over your head, without any fear of overrunning, which is the chief objection against the revolving drum types of reels. The smallest of baits can be thrown out considerable distances, and with practice a high degree of accuracy can be obtained. There are a number of good makes on the market, and being fully explained in the various catalogues, details of manipulation are therefore unnecessary. I have not myself tried one, so cannot offer comment one way or the other for either choice or use. A possible disadvantage with so fine a line is, that it may snap or cut easily in heavy water and snags, there must also be a tendency to kink as with the Malloch reel, but it has proved itself suitable for large fish in many parts of India.

19. *Revolving drum reels and outfit.*—This is the more general method, and is covered by a large range of rods, reels and baits, varying from 7 to 12 ft. rods, and reels from 4½ inches to 3 inches.

The American wide drum reels, with a line guide and a quadruple multiplying wind, are very popular and used extensively with plug-bait and the short rod; they are far cheaper than the English makes and are easy to use. Full instructions are issued with each reel. For those who prefer the larger reels of British make, and price is not a consideration, there is a large choice and almost every tackle maker has one or two to offer. The best known are the 'Silex' and 'Easy Cast', but any reel of the Nottingham type works well if good material is put in. I use a Silex, so will give a short description of how to cast and fish with one, but the methods for casting in general are the same for all reels, provided the correct adjustments are made, and the makers' instructions are carefully followed. Spinning rods are made stiffer and stronger than fly rods, to suit casting a bait from one to five ounces, with good strong and wide rings to reduce friction on the line, so we must adapt our methods accordingly.

This is a double handed operation, calling for good control and timing throughout the whole movement, and is probably the most difficult to learn, but once mastered is most fascinating.

The rod is held in both hands, one behind the reel and one in front depending on whether you are right or left handed.

For example we will take a right handed cast. The left hand operates the clutch lever on the Silex with the forefinger pulling it up as far as it will go, so disengaging the check ratchet, and leaving the drum to run free. With the lever in this position, a felt friction pad is brought up against a metal drum connected to the line drum, and keeps up a pressure to prevent the line drum overrunning when the bait has touched the water. Correctly used and adjusted, this stops the line drum, but if the action of the cast is badly made, there is a tendency to overrun and the line gets

entangled on the drum. Flicking the bait out, or putting too much 'beef' into the cast will cause this. A smooth easy action from start to finish, in the form of a good shot at golf, best describes the action. If correctly made the bait goes out in a straight line, and leads the lead and trace, and no effort is required. The moment the drum stops revolving (which should be as the bait hits the water), the clutch lever should be released, when the check is automatically engaged, and is ready for any emergency. This roughly is the operation of the reel, but now we must consider the cast itself, and how it is done. Here I will quote from Hardy's *Angler's Guide* and reproduce the diagram.

'Holding the rod at an angle of 45 degrees, allow a length of about 1¼ yards of line or trace to hang from the point to the bait. In casting, the movement of the body should be the same as driving in golf, a clean follow through stroke. Jerky casting makes overruns. Please refer to diagram. The Angler is standing at *X* facing *A* where the bait is desired to fall. Turn the body round, until facing *B* merely raising the left heel a little. Swing the bait slowly back pendulum wise to *C*, *D*, *E* or *F*, according to the weight of the bait, and make a cast from any of these points, pressing lever as the cast is made, and keeping it pressed until the bait falls on the water. This is all that is required. The bait is merely swung backwards, and at the same moment as the cast is made, the lever is pressed quietly home. The movements of the initial stroke of the cast, and the pressing of the lever should be simultaneous. When using light baits 4 to 6 drachms, cast from *D*, *E*, or *F*. For baits weighing ¾ to 1½ ozs., from any point *C*, to *H*. Diagram shows how to cast from the right side. If casting from the left the position is simply reversed'.

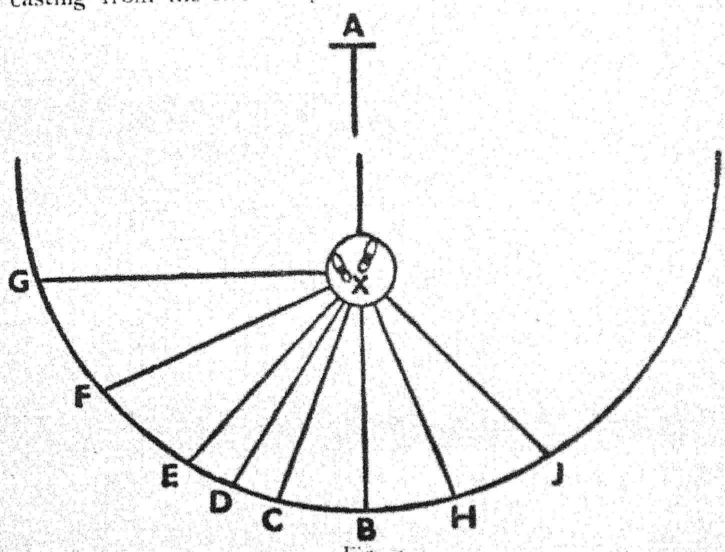


Fig. 3.

The procedure then is much the same as mentioned under fly spoon fishing, let the bait come across and below you, and wind up through all likely water, and repeat the cast.

Points to remember:

(1) Get the reel correctly adjusted to your bait, before making a cast, and again each time you change your spoon or bait. This is most important.

(2) Do not release the lever until the drum has stopped revolving; this is a common fault, and it is frequently used as a check. The reel will soon wear out if you do.

(3) Be careful to wind the reel evenly with line; if it forms a ridge, the coils become loose and entangled, trouble follows, and both temper and fish are lost. This frequently happens when playing a heavy fish, or winding in against strong water.

(4) Before casting, make sure the line is free and not twisted around the tip of your rod, or you may damage the tip, or hook yourself or an attendant, especially if fishing with heavy bait and weight.

(5) A good guide when casting is to point your left shoulder at the point you wish to drop your spoon, and let your hands and arms go back as far as they can, making this the limit of the backward body movement.

20. *Where to look for Mahseer.*

Rivers.—We will take for choice a river in the lower Himalayas or Siwaliks, where for our purpose we will find all the ideal conditions, both for mahseer from a quarter of a pound to five score or more, and an easy hunting ground for the beginner. Twenty miles or so after the Indian rivers leave the hills, they start settling down into a monotonous and easy flow over sand, and from our point of view have little attraction. We must have the essentials which mahseer demand, rapids, pools and rocks.

My own choice is water near and about where the river leaves the last range of hills, especially where large pools are formed and the stream breaks up into a number of channels. If to these conditions we can add two or three junctions of spring fed tributaries, we have the ideal river. Most of the rivers of any size in the north of India rise in the snows: by 'spring fed' rivers I mean rivers that rise in the lower ranges, which are not subject to melting snow in the hot months of April and May.

Rivers which have their sources in the Western Ghats of India and the Highlands of Central India are not snow-fed. Of these the more important are the Narbada, Godavery, Kistna, Bhima, Tungabadra, Cauvery and Bhavani, all of which hold mahseer, as also do the many fine artificial lakes in the Bombay Presidency. The record mahseer 119 lbs.,* and the next largest 110 lbs., were both taken in Mysore rivers, the former in the Cauvery and the latter in its largest tributary, the Cubbany (Kabani).

I will now generalize on the best places to fish, but I warn the novice, that this is much more a matter of keen observation and experience than a rule.

(1) Junctions of rivers, especially if there is a difference in temperature of the water in the two streams, (in May this can vary as much as 8 degrees), or if the parent river is discoloured by

* Since this was written Mr. Verhgen has caught one of 120 lbs.

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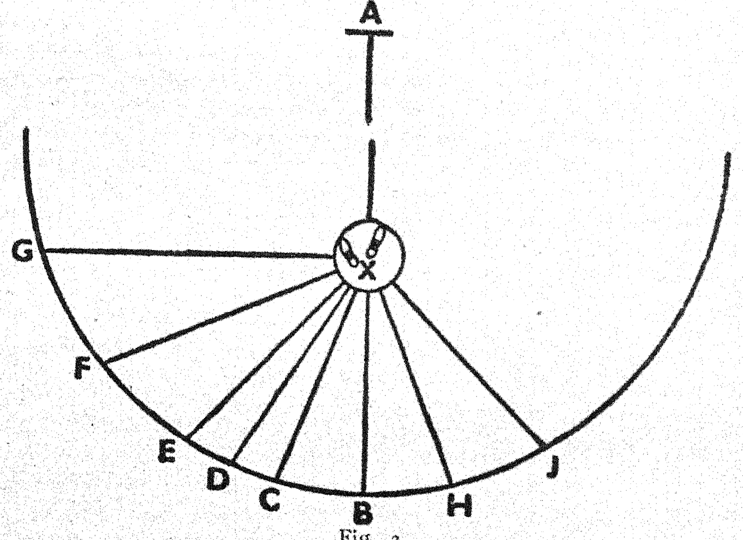
'Holding the rod at an angle of 45 degrees, allow a length of about $1\frac{1}{4}$ yards of line or trace to hang from the point to the bait. In casting, the movement of the body should be the same as driving in golf, a clean follow through stroke. Jerky casting makes overruns. Please refer to diagram. The Angler is standing at *X* facing *A* where the bait is desired to fall. Turn the body round, until facing *B* merely raising the left heel a little. Swing the bait slowly back pendulum wise to *C*, *D*, *E* or *F*, according to the weight of the bait, and make a cast from any of these points, pressing lever as the cast is made, and keeping it pressed until the bait falls on the water. This is all that is required. The bait is merely swung backwards, and at the same moment as the cast is made, the lever is pressed quietly home. The movements of the initial stroke of the cast, and the pressing of the lever should be simultaneous. When using light baits 4 to 6 drachms, cast from *D*, *E*, or *F*. For baits weighing $\frac{3}{4}$ to $1\frac{1}{2}$ ozs., from any point *C*, to *H*. Diagram shows how to cast from the right side. If casting from the left the position is simply reversed'.



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melting snow, or best of all if the small fish are migrating up or down stream. If one or two of these *desiderata* prevail, you can usually count on a singing reel for most of the day, as under these conditions it is not unusual to see a black mass of fish collected in the warmer and clearer water. If the small fish are running, you need only watch the water to see the little chaps scatter in all directions as the big fish take their toll.

(2) Rapids will present themselves in many forms, sizes and depths, but wherever water is fast, and there are backwaters formed, try the point where the reverse and rapid waters meet, all the swirls and eddies formed on the edges, and above all never miss the 'white feather' of water formed by a boulder jutting out, or by a submerged tree, however shallow it may be. In such places feeding fish will always take up their abode. (See photograph facing chapter.)

Fish the whole length of the rapid, from below for choice, as you avoid disturbing the water above while playing a fish. Do not neglect where the current slows down in the pool and fans out on either side; it is generally very good.

(3) The water above a rapid, and at the tail of a pool, if conditions are suitable, is almost the best water of all in the evening. Look for a smooth flow of water, about 3 to 4 ft. deep over large boulders and gaining in velocity above a rapid, with a few stones dotted about out of the water, and making swirls for fish to lie; here excellent sport can usually be had with fly spoon, but remember large fish also lie up in such water.

Pools.—The head and tail of pools provide the best sport for spinning, but trolling will provide good sport if a bait is worked along a cliff face by the small bays, past out-crops of rocks, etc. Dead bait spun deep is the best for this type of fishing and will often produce the heaviest fish. If you see large fish rising in any part of the pool it is well worth trolling a dead bait over the spot while crossing from one bank to the other.

If a *Ficus* tree in fruit happens to be overhanging the bank, give the place a trial by throwing in a few berries to see if fish are interested. Any broken water in a pool is worth a trial; and, above all, a few minutes spent watching the water for movements of fish, while you have a pipe, is very often worth more than hours of flogging the water.

Lakes.—Here the expert with the fly will find his knowledge tested to the full. Small mahseer will come to bag, but the large ones are indifferent to almost any bait. I know only the Lakes of Kumaon where the methods are, to move the boat outside the willows and weeds, dropping the fly just outside in the clear water under rocks, trees, bushes, etc. In general, black or white flies take the best, 'Silver Doctor', 'Zulu', 'Black Palmer', 'Walkers Claret', 'Yellow Spider', and 'Tag of Towel'.

Trolling with dead bait will also sometimes produce fish, but the largest are generally taken on paste.

In 1940 Major Corbet caught a fish of 50 pounds in the Naini-Tal Lake, on fly, but this is very exceptional.

Canals.—In the Punjab and U.P., mahseer are to be found in some of the canals a long way down from the headworks; they are

taken on spinning bait at the falls, or with paste at the various cattle drinking fords. Fish of 30 and 40 pounds have been taken at Meerut and Roorkee in the Ganges canal. The lower reaches have now been spoilt from the angler's point of view, by the grids erected across the falls for the U. P. Hydro Electric Scheme, and no fish ladders being provided.

21. *Gram fishing.*—This form of fishing is almost exclusively practised in the C. P. rivers, where the fish prefer it to any other form of bait. Fish of 10 pounds and under are taken on light tackle, and offer excellent sport. A fly rod and light gut cast with small hooks, provides the outfit. The method of fishing is mentioned in chapter VI 'Fishing for Mahseer'. Fishing with paste is also fully described in the same chapter.

22. *How to play a fish.*—I have been frequently asked by the novice, how is he to know when to reel in while playing a fish? 'Act, Resist and Yield' as the riding master says, answers this question as well as I know. The 'Act' is casting the line, and recovering it at every possible opportunity.

'Resist' by lifting the point of your rod and applying all the pressure you can from the reel, *but through the rod.*

'Yield' to the rush of a fish, when his power outweighs yours to resist. Substitute your pony's head for the fish, your reins for your rod and line, and you yourself be the angler. Carry these aids into practice with a hooked fish, and you have the answer. It comes natural after you have been taken once or twice, the rod itself being an indicator. A fresh and lively fish will frequently pull the point down in his rush, and the tiring fish come in and allow the point of the rod to be kept up, and so ease the tension. Here again is yet another approach to explaining when to resist or yield. Get into your bones the maximum tension you can safely apply with your tackle, to a fish. When he goes beyond this, you can only adjust it by giving line, and when he comes within, you can only maintain it by winding in. An even pressure on the fish all the while, will kill in the shortest time, but do not hurry matters, as a mahseer will not give in until thoroughly tired.

General

I will conclude this chapter with a few remarks which may be useful to those not acquainted with conditions met with in the fishing season or on a first trip.

23. *The best season.*—In Northern India, the best season is February-March-April for the large rivers, as they are most likely to be clear, and the volume of water is at its lowest. Junctions in the hills are best when one river is discoloured and the other clear, but are good at all times. The smaller rivers, that is those which are not affected by snow water, are best in October and early November; but fever, and very often roads and communications, present difficulties. Generally speaking the early hot weather is the best time. In Assam and Burma however the best bags are made in the cold weather, especially in spring-fed rivers, and at their junctions with the larger rivers.

In the rivers of Bombay, Central India, Mysore and Madras the season for mahseer fishing with spinning baits and fly is, generally speaking, from the time the rivers begin to clear after the monsoon floods, the best sport being obtained early in the season before the water has run low, after which the larger fish are mostly in the deep pools and not easily found. In some parts, September-October, between the two monsoons (the S.E. and the N.E.) is also a good time: but conditions vary from year to year. All the *big* fish are taken by means of *ragi* paste, bottom fishing; and fish of over 50 lbs. are seldom taken by spinning.

24. *Kit.*—Footwear is severely tested, and although I have tried most types of boots, I am of opinion that good thick soles, with plenty of nails (both in the boots and carried spare), are the only answer to the slippery stones amongst which one is forced to wade. Rope soles may suit certain rivers, but nails suit all. Mumrogan or any other leather dressing should be applied daily, and spare boots taken. I myself carry three pairs of army boots, using them in rotation. Avoid rubber soles at all costs. In October in some rivers the rocks are not nearly so slippery as in March-April, where in places they are like bars of soap, and tosses are frequent however much care you take.

A correspondent sends me the following information regarding footwear. 'I have tried boots with hob nails (single and treble), with rope soles with coir (the same as a coir mat) soles, soles with latitudinal leather bars screwed on (just like a rugger or soccer boot), and, last but not least compressed felt soles. For both non-slip and wearing qualities, these felt soles have no equal, and I shall never wear anything else. Mine are four years old, and show very little signs of wear and will see me through many more years of the hardest fishing. I find I paid £1-13-1 (including postage). These may be obtained from Messrs. J. A. Hawkes & Sons, Ltd., 99 High Street, Poole, Dorsetshire, and are a product of the Gutta-Percha Company. I really believe that you will be doing a very real service to the fishing fraternity, by recommending the compressed felt sole, and giving it all the publicity possible'.

Shorts are the best and the most convenient, if your knees are hardy and can stand sun-burn.

Shirts with long sleeves or short, just whichever suits you. In Burma and Assam insects are a nuisance, and biting flies, from a quarter the size of fleas to the large green-eyed horse-fly, descend on one ravenously, and make life most unpleasant. They are not so bad in Northern India. I have a sleeveless coat with plenty of pockets which button. This is handy to carry the odd pair of pliers, small turn screw, penknife, small box with spare spoons, hooks, swivels, etc., and a book with casts and traces. Cigarettes carried in a shaving soap tin is a useful tip, as they keep dry and are not ruined if you wade in over the pockets or take a toss. Buttons on the pockets save losing stuff, if you should fall or get carried down stream.

Spares, such as reels, wire, hooks, weighing machine, camera and note book, can be kept in a haversack on the bank, by an orderly or attendant, or in your boat.

Medicine chest.—Carry all necessities for fever, burns, stings, cuts, etc., dealt with in detail elsewhere. Chapter XII.

Comforts.—Cheap cigarettes and sweets are very much appreciated by camp followers and jungle folk. Woolworth trinkets, and copper pice by the women and children. Where the custom is to chew tobacco, free gifts of the dried leaf will greatly encourage willing service by baggage and camp coolies: so a sufficient supply should be carried (in a special bag, or all your possessions will be highly odorous).

In the quarterly, *Angling*, now a *Country Life* publication, is a series of articles by Mr. H. Chapman Pincher, B.SC., F.Z.S., F.R.M.S., which are expertly written, highly informative, and of the greatest interest to anglers. They are elucidated by text-figures and include Functions of the Swim-bladder in Fishes; Locomotion; Hearing; Scales and Scale-reading; Colour in Fishes; Breeding; Vision in Fishes.

Angling is a publication within the reach of all, being readily obtainable for an annual subscription of 5*s.* 4*d.* post free.

CHAPTER V

Tackle for Mahseer.

I. HEAVY MAHSEER TACKLE—Rods (1), Reels (2), Lines (3), Splicing Line (4), Traces (5), Swivels (6), Connecting Links (7), Attaching Trace to Line (8), Weights (9), Lures (10), Mounts (11), Split Rings (12), Plugs (13), Spinners (14), Mounting Dead Bait (15), Legering (16), Weighing Giant Fish (17), Gaff or Spear (18), Baiting Needles (19), Disgorger (20), Repairs to Rod (21), Line Drier (22).

II. TACKLE FOR SMALLER FISH—Medium Mahseer Fishing (23), Rods (24), Steel Rods verses Split Cane, Greenheart and Ringal (25), Thread Line Rods (26), Double-handed Casting Rods (27), Solid Cane or Ringal Rods (28), Double-handed Fly Rods (29), Rod fittings (30), Reels American (31), English Nottingham Reels (32), Stationary Drum Reels (33), Casting Line (34), Thread Line (35), Traces (36), Lures, Plug Spoons Dead Bait (37).

III. FLY SPOON AND SINGLE-HANDED FLY ROD—The Rod (38), Reels (39), Lines (40), Traces (41), Treatment of Gut and how to tie Traces (42), How to tie a cast (43), Knots for Traces (44), Knots for attaching gut to swivels (45), Lures (46), List of Tackle Dealers (47).

A chapter on tackle could fill a tome, were I to go into detail of past and present, and illustrate the outfit freely. This is quite unnecessary in view of the excellent Anglers' Guides now offered by the many tackle makers, and by dealers, both in this country and at home.

Get a well-illustrated catalogue from Hardy, Allcock, Farlow, Albert Smith or with whomever you deal, or better still out here from Mantons, the Army & Navy or Verona, and you will be equipped to study the various forms of baits, knots, etc.; besides which they have a number of instructive notes.

In the first instance 'Tackle for Mahseer' is an indeterminate Heading for this chapter, when it is considered that this fish offers sport from ¼ of a pound to 5 score or more, and that consequently tackle must be classified or grouped for 'Heavy', 'Medium', and 'Light' fishing; so I will subdivide this chapter into three parts.

I. HEAVY MAHSEER TACKLE.

By 'Heavy' I mean big water and looking for big fish, that is for fish 30 pounds upwards. This type of fishing is almost exclusively enjoyed in Burma and Assam, it is best done from a boat, as the water is too big to command from the banks, and very often the best places are from islands in the river, or at large junctions. It is a type of fishing unto itself. To illustrate the type of fishing I am dealing with I will quote just two such trips; one from Assam and one from Burma from 'The Angler's Hand Book' by Lacey.

Assam.—'The river is called the Punateet, and runs out of the Khasia hills at Laour. To get to it, you have to branch off at Sonamgunge (on the Soormah) and go by boat to a village called Elamgao; here you can get Dingies and boatmen to take you up

the gorge, where you must rough it in a grass hut. It is a beastly unhealthy place. Every time I go there all my servants are knocked over with fever. I got it once myself, but on that occasion I was there six weeks. Extract from my diary:—

November 19th got nil, lost 4 fish.
,, 20th ,, 1, lbs. 19, lost 3.
,, 21st ,, 2, ,, 30, 36.
,, 22nd ,, 6, ,, 46, 31, 41, 25, 13, 12.
,, 23rd ,, 2, ,, 44, 30.
,, 24th ,, 2, ,, 24, 32.
,, 25th ,, nil, gave the good pools a rest, and tried some new water.
,, 26th ,, 3, ,, 18, 58, 55.
,, 27th ,, 3, ,, 29, 29, 62.
,, 28th ,, 8, ,, 16, 54, 20, 33, 7, 32, 33, 26.
,, 29th ,, 2, ,, 28, 26.
,, 30th ,, 1, ,, 28. Tried new water again.
December 1st ,, 1, ,, 21.

Of course besides these fish I lost several, of which I kept no account. I got them all trolling with spoons 4 inches long'.

Burma.—By Lt.-Col. H. D. Keary.

'Lt.-Col. Taylor, 30th M. I., and myself, fishing from below the Rocks up to and about the Confluence, between the 1st and 21st April, 1903 took sixty-six fish, weighing a total of 696 lbs., the biggest fish being 45 lbs., second 43½ lbs., and third 35 lbs.; many other large fish were hooked which broke us. I had on one fish for five hours, and had gone between two and three miles down stream with him, when he got me hung up in a sunken tree in sixty feet deep water, where it was impossible to clear the line, and I was obliged to break; what the weight of this fish was I don't know, but at the end of five hours' very hard fighting, with no rests or sulking, he appeared pretty nearly as lively as when first hooked; and to give some idea of what he might weigh, I may mention that the day before I killed a 43½ lbs. fish, only very lightly hooked through the skin of the top of his head, in about 1½ to 2 hours in exactly the same place as I first hooked this big one'.

I have, myself, fished the water mentioned by Keary, and taken in 28 fishing days, between the 11th April and 8th May 1928, fifty-three fish weighing 861½ lbs., the five best being 75, 50, 48, 44 and 42 lbs. I also lost a fish, after playing it for over two hours.

Heavy Mahseer fishing is the privilege and good fortune of a select few; indeed, there must be few anglers in India, who would need more than five fingers to count the fish they have caught over 50 lbs. So that although it does not cover the general needs of the average angler, it is none the less the cream of sport with this fish, as a real big fish in big water is awe inspiring, and calls for

extreme skill in handling and playing. The tackle must be good and strong, and the whole team of boatmen and angler, in full accord. Perhaps the greatest change during the last 18 years, has been in the methods, and tackle now generally in use.

1. *Rods.*—The old idea of long sixteen feet rods, heavy spoons, and baits, have given place (thanks to the advance made by tackle makers of strong light and pliable rods) to ten and twelve feet rods, now almost universally used for the heaviest fish. Split cane, steel or green heart, are all popular; and for the man of limited means the ringal or bamboo rod made out here is strong enough to land any fish.

For this type of fishing we must take into account the heavy water to be fished, and with it, the large bait and weight that is necessary to work such water. Rapids may be twenty feet deep and two hundred yards across, and the volume of water will run the reel and bend the rod in two while the spoon is spinning, in fact a large spoon gives a strain of 2½ to 3 lbs. while reeling in, in fast water (I tested this myself as a matter of interest). The backaches after a day of this type of fishing, are a ready reminder of the strain to which both body and tackle are put. Another matter to bear in mind is that while playing a heavy fish you will have out between 100 and 200 yards of line for the first half hour or so, and it is extremely difficult in big water to control a fish with any but a strong and powerful rod; as an instance of this, just feel the stresses and strains your line and rod are put to when you get hung up in big water; this is what the fish is subject to when hooked and deep down in a rapid. So that a strongly built and stiff rod becomes pliable under these circumstances, but fish as light and with as pliable a rod as you can. I personally recommend the two-piece ringal or bamboo rod, with a spare top, and protected porcelain rings throughout, built by Verona or Mantons, as fitting all one's needs for this type of fishing. Verona will make up a rod to any specifications, and turn out an excellent job, and one can buy six of these rods for the price of one of Hardys, or the other better known makers. If one is to be stationed near big water, and price is of no consequence, then the other more expensive types can be purchased.

2. *Reels.*—A large reel, to take 300 yards of grade E (or 30 lbs. breaking strain) line is necessary, and here I strongly recommend the best reel you can afford, as it is in my opinion the most important part of the outfit; and any reel, except perhaps the sea fishing types, is called upon to do more than that for which it is built. I use Hardy's extra wide 4½ in. silex, which is probably the most expensive of all casting reels, and frequently I have to go over the reel to tighten screws, nuts, etc., after running a big fish. I had an extra wide Decantelle reel, built specially for me by Hardy's for this fishing, and found it stood up to the heavy work much better than the silex, and is excellent for casting a heavy weight though it does not 'sing', but, both hand pressure and braking can be applied if you indulge in this pernicious habit.

3. *Lines.*—Braided silk lines, 'Lignum Vitae' or Non-pareil, (both American), far surpass anything yet put on the market. They are

strong, reasonably priced, and wear for three or four seasons if looked after, and dried daily after use. Dressed and enamelled lines want a great deal of care and attention out here, and either go tacky or rot, the enamelled lines get brittle and crack. This has been my experience. 'Lignum Vitae' and 'Non-pareil' are made in a number of grades, and I recommend a breaking strain of 25/30 pounds, for this type of fishing, depending on whether your reel can take 300 yards of line or not. This is most important.

Backing, for preference, should be line of flax or hemp, and slightly stronger than the braided line. If a twisted line is preferred, 'Donegal' Cutty Hunk is finer, relatively, than most other lines, for its strength, thus enabling you to get more line on to the reel. A rough calculation for line is to multiply the breaking strain by four, this gives the weight in pounds of the fish you should be able to capture ($30 \times 4 = 120$ lbs.).

The weakest part of the line is at the knot, so avoid, if possible, making knots, by splicing a loop at the end of the line where it joins on at the trace as in fig. 4.

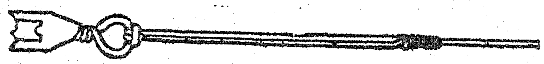


Fig. 4.

Line can usually be bought in 200 yards lengths, but if backing is to be attached never join them by a knot, but by a long splice, of not less than $2\frac{1}{2}$ inches, in the manner described here. This also applies to a broken line.

4. *Splicing Line.*—Pick the ends of the line, open carefully with a needle or other convenience, as in fig. 5 *a*, to one inch or more from the end, then flick in the manner of a whip, this opens up the silk threads. Then wax over and fork into two points as in (fig. 5 *b*) of diagram, close the forked ends into each other as in fig. 5 *c* of diagram and lash together with strong waxed silk (fig. 5 *d*) and dry.

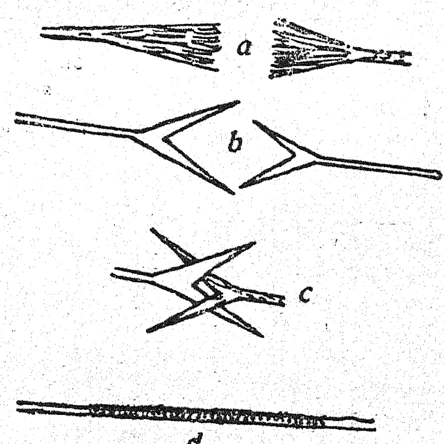


Fig. 5. *a, b, c, d.*

5. *Traces.*—Horwoods Killin wire traces are the best I have used, and I can thoroughly recommend them as being the most reliable and the least conspicuous in the water, and is by far the best wire for traces on the market to-day. Use strong or medium gauge. If the wire kinks after the strain of playing a fish, it can quite easily be

rectified by replacing it from a spool of fifty yards carried spare, which can be obtained for Rs. 3-4-0 from any tackle dealer.

Wire traces are made up in a couple of minutes with the aid of a pair of pliers and a spool of Killin wire. Cut away the old wire from the swivels and replace it with similar lengths from the spool. Care must be taken to twist both wires evenly round each other for three or four coils, then twist the short end around the main wire and cut as close as possible. This is best done by passing the short end through the eye of the swivel, bending it around and holding it where the wire crosses over (fig. 6 *a*).

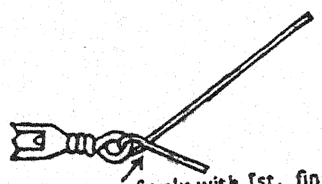


Fig. 6 *a*.

With the ends crossed and made to form as angle of approximately 45 degrees twist evenly with the swivel held taut and firm, repeat this for three or four turns, then twist the short end around the longer end and cut close (fig. 6 *b*).

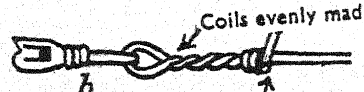


Fig. 6 *b*.

If the twist does not come evenly, cut away the bent wire and try again. If the long wire is twisted around the shorter end in the first coil or so, it is liable to break under strain, so be very careful to avoid this happening. If the shorter wire is bound around the longer of the two, without the even twist near the swivel, it is apt to draw down on to the swivel and pull open. A watchman's small vice together with pliers, will tend to quicker and better work.

6. *Swivels*.—Only use the best, as you can then use the smaller sizes, 6 or 8, for the heaviest fish. Spare swivels should be carried in a small bottle in oil, they keep like this indefinitely. Link swivels for this heavy type of fishing should be specially made and I strongly recommend the type I illustrate with the Myitkyina spoon, these were specially made by Hardys for me, and I have not had them fail me once. I give four types of American connecting links which are both hardy and strong to use, and which are obtainable from

most tackle dealers out here. (See fig. 7, 1 *a* and *b*, 2 *a* and *b*, 3 and 4).

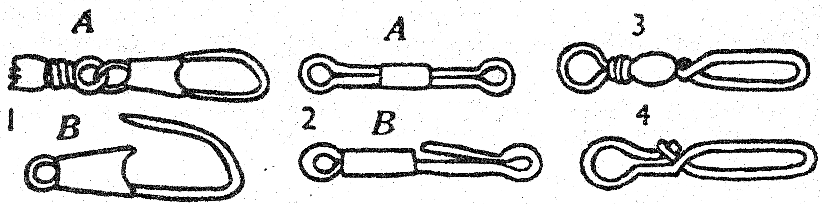


Fig. 7 *A* & *B*.

7. *Connecting Links.—These make a good substitute if you are* out of link swivels, though they are not, unfortunately, rounded off or pear-shaped like the attachment I have recommended above.

8. *Attaching Trace to Line.*—The best way to attach your trace is by a large loop spliced on the line, this can be passed through the eye of the swivel and over the bait then drawn tight, making a double loop on the eye of the swivel, apart from strengthening the join with the trace it also can take up any wear caused by the weight. (See diagram under 'Lines').

9. *Weights.*—For casting a heavy spoon and getting the full use from it, weights must be used, there are many handy shapes and sizes made, as reference to any fishing catalogue will show. 'Anti Kink', 'Barrel', 'Spiral', etc. If possible, never attach a weight permanently to your trace, this is the cause of more fish being lost than any other, as they invariably foul snags and rocks, while playing a fish, besides getting one hung up. Use only leads that can be attached in a temporary sense, to the trace by a strong piece of silk, which would snap if fouled and so lose the lead but release the line. A barrel-shaped lead with a hole right through to pass a silk thread for tying, is what I use and recommend. The spiral type is also good, so long as they are not securely fixed to the line (fig. 8 Barrel Lead).

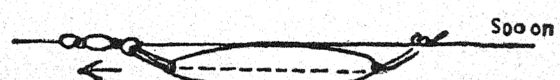


Fig. 8.

With a four-inch spoon in heavy water use a four-ounce lead and you may even require one heavier, though four ounces should be good and heavy enough for most water with a flat spoon. With the hog-backed spoon a much heavier weight is necessary, as it takes a greater hold of the water. When fishing for the big fellows search the bottom with your bait; and even though you lose tackle you will be rewarded in the end; for then only will you catch the 'Grandmothers'.

10. *Lures.*—Spoon has a distinct advantage in big water such as we are considering for this type of fishing. As I have explained elsewhere it has greater searching power than the other lures, plug,

dead bait, etc., in fact it is almost exclusively used in Burma for this type of fishing, and also in Assam.

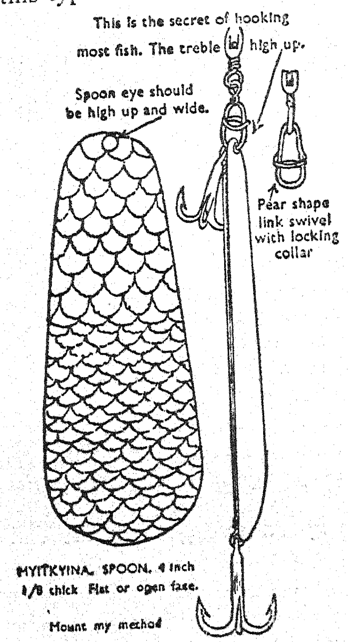


Fig. 9.

Spoons, like flies, have their fanciers, and it would be folly to eulogise at length on any one particular kind. I can only suggest that with certain localities we find some spoons better than others. This, more than fancy then, should be our chief study.

There are certain general principles to be kept, while fishing with spoon. The clearer the water the duller the spoon; the duller the water the brighter the spoon; likewise, the shallower the water the smaller the spoon; and deeper the water, bigger the spoon; the faster the run the flatter the spoon; (open faced and narrow). Then for trolling in a pool with slow water a hog-backed spoon is most suitable. The spoon is subjected to many combinations of colours, gilt and silver, copper and silver, all silver, all brass. The duller surface is usually the larger surface of the spoon, as made up by tackle makers. It is a good plan to have a few of each in both sizes and shapes with the colours reversed. I myself, fancy the Myitkyina type of spoon, as it gets down deeper than most of the other types, and I believe a narrow spoon increases the chances of hooking a fish, as his mouth is able to close further than on the broad hog-backed type, the scale effect deeply cut into these spoons appears to attract fish more than the plain types. See fig. 9.

11. *Mounts.*—I am, myself, in favour of the flying mount with two trebles for large spoons (fig. 9).

A piece of galvanised wire the thickness of a stout spinning line made up to fit spoons of all sizes, in the following manner. Make a loop at either end of the wire, each containing a treble the tail hook to be larger than the top hook. Avoid using very large trebles as they are quite unnecessary. I would call size 1 in trebles large enough for any mount in the tail hook, and size 4 for the top hook. Use only the best, either Hardy's oval wire or Verona's treble brazed; these sizes are for spoons of 3 to 4 inches long. Carry spare mounts, and spoons separately in suitable boxes, these can then be threaded on to the pear-shaped link, (as recommended by me) in a few moments, when a change is necessary. The correct length of a flying mount is half the loop and treble clear from the bottom of the spoon (fig. 9).

I give this form of mounting as it is my own, and is not men-

tioned elsewhere; other forms are well illustrated in tackle books, and can easily be followed or copied to one's own particular fancy.

12. *Split Rings.*—For large Mahseer fishing I can only repeat what Thomas said in 1887, Lacey in 1905, and Skene Dhu in 1923, 'Don't trust them'. They are the cause of more temper and fish being lost than anything else.

Do not be tempted by them under any circumstances, or you will share the fate of many of us. Strike perhaps only one fish in the day, and then the split ring goes! I will never forget my own experience of seeing and stalking a monster fish, and after the case of everything being in order, I was left nothing but the want to use all my Dockyard vocabulary on the maker who made that 'Split Ring'. We are guided by experience, and if you are wise you will take this advice. Use the link swivel or collar attachment, or attachment link, they are just as convenient and more reliable.

13. *Plugs.*—Plug has, in recent years, become very popular, and has been used with great success both in India and Burma. They are very attractive in appearance, and are most realistic in fast water. The jointed types are favoured in slow water, and the one-piece for fast water. The makers (American) mount them with three trebles as a rule, but the hooks are too flimsy for Mahseer, and must be replaced with any of the special trebles made for fishing in India. They are made in all sizes, and have one great advantage over spoon in that they are heavy enough to cast without a weight, if necessary, and by the aid of the inclined plane keep under water, and do not get hung up in shallow rapids anything like a spoon. They are offered in a variety of colours and shapes, and stand a lot of rough use.

14. *Spinners.*—Devon or any other types of spinners are attractive and take well in certain localities, but are expensive, when it is considered that they give very little advantage, if any, over the spoon or plug. A couple, however, are handy to have by one, to try out, if other lures fail.

The Crocodile, Archer, or any of the other many makes are all good for mounting dead bait in a hurry, but none are as effective as the double mount threaded through a dead bait, as dealt with in detail, further on in this chapter.

15. *Mounting Dead Bait.*—If fish are shy, take trouble over mounting your dead bait, and you will be rewarded. If, on the other hand, fish are well on the feed, a Crocodile or Archer Spinner will be quite effective. The method I use, which is by no means original, is I think the best for mounting a dead bait. When mounting dead bait, it should be borne in mind that the act of the current helps or retards the rate of spin. A current setting towards one's own bank will rotate a bait which has a right-handed spin, faster than one with a left-handed spin; and vice versa. For different types of water the pace has to be different; and as water on the near bank is often placid the faster spin, obtained as above, is desirable. Different types further need a different spin. If the pace of the spin is correct the bait is more likely to induce a fish to seize it. It is the pace that kills—the correct pace. All fins of a dead bait

should be cut off with a pair of scissors—except the anal fin. A bait whirling round with fins rigid in death, sets up too violent waves of disturbance in the water. If the bait rotates too slowly it will not be taken; as already said—the pace it is that kills.

My method requires a reel of silk, a wide eyed needle, trebles mounted on suitable lengths of wire, a baiting needle and an attachment link. I have a tin with an assortment of mounted trebles, of varying lengths, in my bag, as getting the correct length of wire to suit a dead bait, is important. I mount my hooks on twisted Killin wire, which I coat with solder or 'Tinol'. These last indefinitely and are easy to mount, and do not break up the bait when drawn through from the vent. The method of mounting is quite simple and is done as follows. Get a suitable size of dead bait (4 to 6 inches is the best) and suit two lengths of wire with the mounted hooks, to the fish; see fig. 7 *a* and *b*.

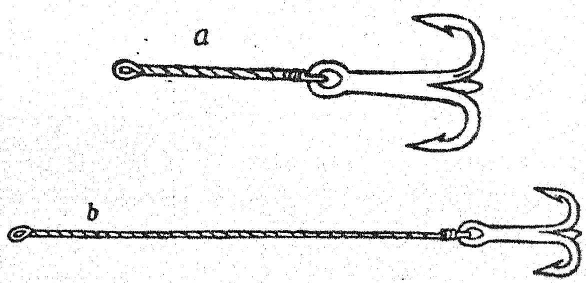


Fig. 10 *a* & *b*.

'a' should be just long enough to pass from the mouth to behind the gill, and is passed through the gill out through the mouth and threaded on to Attachment Link on Trace, as shown in fig. 10 *c*.

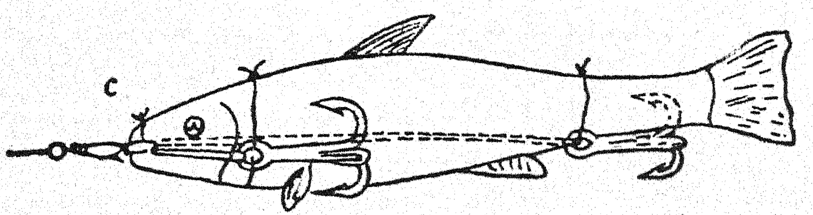


Fig. 10 *c*.

'b' should be threaded to a baiting needle, and run up through the vent and body to the mouth of the fish, the loop then threaded on to the Attachment Link. Pass a fine needle threaded with silk through the head from above, and through both wire loops on the Attachment Link, then through the lower jaw of the fish, run the silk through and then tie in front, and through the Attachment Link (fig. 10 *c*). One barb of the treble on wire 'a' should be fixed into the fish, the hook on wire 'b' should be fixed so as to give the dead bait a kink, depending on how much you want it to spin, both hooks should then be threaded in turn with silk or strong cotton either through the eye of the treble or over the

shank, and tied around the fish as shown in fig. 10*c*. The shorter the gill treble mount the better, and I prefer it to have the larger hook of the two, but this can be suited to one's own fancy.

A correspondent sends me the following:—

'I think the use of twisted Killin wire—which necessitates tinning or it will rust—would bother a novice. And as there are rustless steel wires on the market these are preferable. I have such steel wire—an American product—which is admirable for bait mounting. It takes solder readily (use broken spirits of salt). It is absolutely rustless; even under any salt water conditions.'

'The wire is readily manipulated with pliers. Being so thin it does not tear the vent: and its glitter does not matter. I use both this wire and rustless steel twisted wires—for dead bait—rather than Killin. It is made by Wickwire Spencer Steel Company, New York City and San Francisco. No. 7 breaking load 73 lbs. is suitable (this is finer than an ordinary spinning line). It is called Wissco Leaderwire, polished stainless steel. A heavy coil is obtainable for Sh. 5/6*d*. Obtainable from Verona, Dharamtalla Street, Calcutta.'

Another good mount, and one that I use in fast and heavy water is a Crocodile mount, but with a diving shield, much the same as plugs. And I have found this mount more effective than any of the more elaborately turned out ones as offered by tackle dealers. See fig. 11.

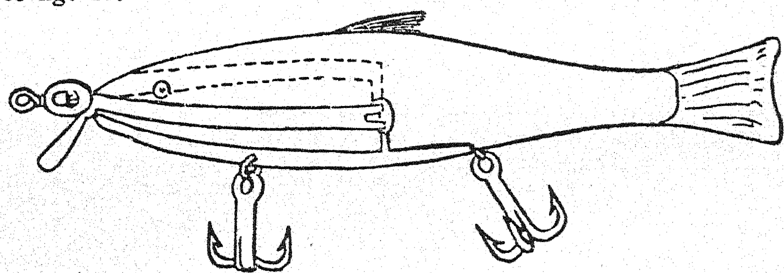


Fig. 11.

16. *Legering*.—Pass the line of the mount, doubled, through the eye of a single hook, give it three twists around the shank of

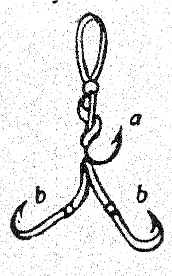


Fig. 12 A.

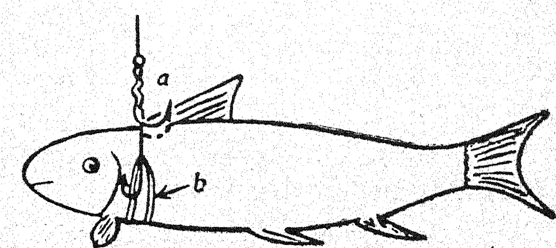


Fig. 12 B.

the hook, then fix to end of mount on either side of fish, a small single or treble hook. (See fig. 12 A).

Fix hook *a* lightly through the skin of fish in front of dorsal fin, and the two hooks *b* one on either side. Pass a rubber band under fish and over both hooks to keep them flush with the side, and in position (fig. 12 B).

Another method, is as in fig. 12 C. *c* is fixed in the same manner as in fig. 12 B, *a* with a single treble attached at end of mount, which lies loose by the side of the fish, with one barb of treble under and just free of the belly. Active fish may get the loose treble hung up on the bottom. The first method is preferable.

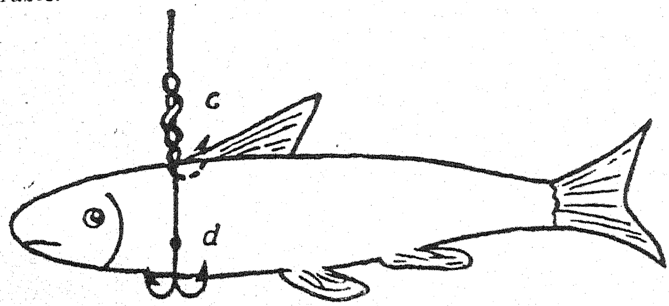


Fig. 12 C.

17. *Weighing Giant Fish.*—If your fish is heavier than your scale register, the correct weight can be arrived at as follows. That is if you have two spring balances. Tie your fish to a stick, and with a scale fixed at either end of the stick lift the fish and the sum of the readings on both scales will be the weight of the fish.

18. *Gaff or Spear.*—The Mahseer, for his size, has the largest scales of any other fish in India. On a large fish they are as big, and sometimes bigger than the palm of the hand, and are very tough. This makes the use of a gaff difficult, even to an expert. Moreover, the attendant one has with one on a fishing trip, is usually a passed master with a spear, and for this reason I advocate the use of a spear with a barb to it. It is more effective and more penetrating than a gaff, and is just as handy to carry.

19. *Baiting Needles.*—Keep half a dozen baiting needles with you, they are always handy, and are easily lost.

20. *Disgorger.*—Be human, and as soon as you have your fish shelved, knock him on the head and kill him. A disgorger can then be used, or a knife or scissors to cut out the hook. I have seldom found a disgorger necessary, but it is useful at times and is quite handy stuck into one's topee.

21. *Repairs to Rod.*—This would only apply to a green-heart or bamboo rod but is worth mentioning, should any one be fixed in the unfortunate position of only having the one top to a rod, and breaking it while on a trip in some remote part. Cut the two broken portions diagonally across so that they will fit (fig. 13 A). Then with Durofix stick them together, and bind over neatly with strong silk. First of all fix the end of your silk along the splice or groove of the two sections. Continue past the splice and secure your end in the following manner. Before finishing the binding, and when

about eight coils remain, put a loop of silk at the end of the binding, as shown in fig. 13 C. Thread the loop with the end of the silk and draw through under the binding. Cut the end close and varnish over. If the break is where the wood is thin, towards the tip of the joint—the splice will be strengthened by a bird's quill—halved lengthways and bound beneath the silk wrapping.

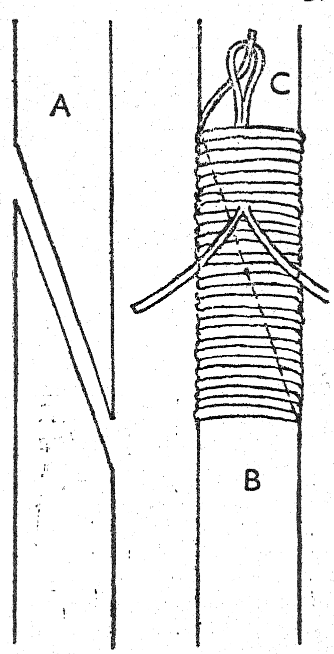


Fig. 13 A, B, C.

22. *Line drier.*—This is a most important item in the outfit, as unless the line is dried daily after use, the lower coils of line on the drum will remain saturated and rot.

II. TACKLE FOR SMALLER FISH.

23. *Medium Mahseer Fishing.*—In part one I have dealt exclusively with the tackle for heavy work, and fitted my remarks to water where the exception is the small fish, and the rule the large fellows.

In this second part I will reverse the order, and consider the tackle which will suit the smaller size of fish. That is, fish from 30 pounds or so downwards, but be up to taking the large ones should they come our way.

For choice, this type of fishing is preferable from the point of view of sport, as it produces more fish, and is as often as not in water where fly-spoon fishing can be combined, and affords rest from the otherwise hard labour that the heavy fishing entails. It is a general condition in most Northern India rivers.

Tackle will cover a wider range in variety and fancy for this type of fishing, as fish from 10 to 30 pounds can be taken in many ways if conditions permit.

The angler in the Doon, and in other suitable rivers, will perhaps use nothing but plug bait, with an American wide drum casting reel, and short steel or bamboo rod.

In still smaller rivers, or where conditions suit lighter tackle, the lover of the Wanless or thread line tackle will stake his wits against the largest fish.

Then there is the more orthodox and perhaps conservative method with revolving drum and double-handed casting rod. Lastly, the lover of the fly rod, who would rather cast a one-inch spoon with double-handed fly rod all day, and take his chances with the big fellows, than use casting rods and tackle.

24. *Rods.*—The short single-handed casting rod, of 5 feet or so, and in case of heavier fish, up to 7 feet in length, are generally popular.

25. *Steel Rods* versus *Split Cane, Greenheart and Ringal.*—The makers of the well-known Apollo steel shaft for golf clubs, have

put on the market a variety of steel tube rods, in varying sizes and weights comparable with split cane or greenheart. In considering the merits of the steel rod, and in comparison with the split cane, I have no hesitation in saying that I prefer the latter, as it is more sympathetic with our cause, and reacts with more smoothness than the steel rod; besides it is lighter. We must, however, consider the many other aspects. For instance, the effect of the climate on a split cane or steel centre rod does not arise with the steel rod, nor does it cost as much, or call for the same care and attention when in and out of use. Then there is the ringal rod of 5 to 7 feet, built for this light work, in this country. I have seen an excellent rod turned out by Verona for this type of fishing—light, strong and a finished job, and at a moderate price. So I would advise, for the extravagant, a Hardy's 'Victor'; for the 'Inquisitive' a steel rod by Apollo or any other maker, for everyone else a ringal cane made up out here, by your tackle dealer.

26. *Thread Line Rods.*—These are made, and carefully calculated out to give a required tension with a fine line, with breaking strain of 2 to 8 pounds, by what is known as 'Test Curve' or 'Strain'. This is roughly speaking, putting a full strain on with the rod, until the line and tip of the rod are in a continuous curve, and the angle disappears. Something of this sort is necessary when it is considered what toy tackle this is, and what the effect of getting the rod, reel and line out of balance, would result in. A stiff rod would put more strain on the reel, and in turn, a stiff reel on the line, (and if the rod is a light one) on the rod too. So that rods for this type of fishing must be carefully selected, and suited to both reel and line. Makers generally grade the rod to the strength of line to be used, so this should receive your careful attention. The length generally favoured is from 5 to 7 feet.

27. *Double Handed Casting Rods.*—There is a wide selection from which to make a choice, as this form of fishing is more generally in practice than the two foregoing, and is nothing more than a modified form of part (1), but as the general run of fish will be smaller, we must have a rod light enough to fit these conditions. Probably the most popular rod is one of about 9 or 10 feet in length, and about 10 or 12 ounces in weight. If an expensive rod is required the 'Wee Murdock' by Hardy in split cane or greenheart, or any other similar rod is all that is desired. The steel rod for those who prefer it, or the ringal cane built out here.

28. *Solid Cane or Ringal Rods.*—Verona built me a nine-foot ringal rod to my specifications, and is all that is desired. I have killed several fish over 30 pounds with it, and over 2,000 pounds of fish all told, it is still as good as new. It cost me Rs. 15. I had to fix my own handle and rings. For another Rs. 15 or Rs. 20 Verona would fix a cork grip and porcelain rings, and personally I would use nothing else. No fear of binding cutting or cement opening, and the chances of repair to a solid ringal if a ferrule gets slack, or a break on a fishing trip, is so much easier than is the case with a split cane rod. I am convinced that as the building of these rods improves in this country, so will we see the exit of the expensive eight- and nine-guinea rod built in England and elsewhere.

29. *Double Handed Fly Rods.*—There are quite a few anglers in

India who prefer the Salmon fly rod to anything else, and get as good sport, but wielding a 12-foot double handed fly rod in an April sun, is hard work. It is grand sport getting into a big fish, and if you wish to make comparisons of the fighting qualities of Salmon and Mahseer, then take on a Mahseer with this tackle, and compare timings, etc., with your catches of Salmon. Individually, you will be satisfied I think. I have kept detailed notes of my fishing trips, and here are three extracts from my diary.

24th April 1935. (1) Fishing in the Sarju in Kumaon, above Bageshwar, at top of Balaghat Gorge, with a 10-foot fly rod, a medium trout gut trace, and one-inch spoon. Hooked at 6 p.m. landed at 8-30 p.m., 600 yards below where first hooked and in third pool down. $29\frac{1}{2}$ pounds. (No sulking).

20th March 1938. (2) Fishing in Nepal in a river about the same size as the Sarju, 25 pounder hooked in 'Bootha' rapid at 9-10 a.m. (my wife kept the time) at top of run, followed him down bank 600 yards, with 100 yards of line out, to tail of pool, then up again half way up rapid and back down into pool. Killed at 11-20 a.m. on the same tackle as mentioned above. A black Mahseer.

12th October 1940. (3) Ladhya River, Kumaon. $9\frac{1}{2}$-pound Mahseer, hooked on 10-foot Perfection Rod, medium trout gut cast and half-inch spoon. Killed in 49 minutes. (Time taken by my two companions.)

These are not isolated cases from the point of view of fight, though they are lucky for the size of fish, as the usual run of fish was very much smaller. The charm of this type of fishing is that you avoid all the 'ironmongery' as used on spoons, plugs and dead bait, of two and three trebles, but just have the one single hook on the fly spoon, and so get as near home conditions as possible. The type of rod needs no mention here, a fly rod used for heavy Trout and Salmon, fits these conditions also.

30. *Rod Fittings.*—Use only the best rings. The expensive rod is usually fitted with good rings, but watch the cheaper ones, and insist on Agate or protected Porcelain rings at the butt and end. Ferrules, either 'lock fast' or 'Suction', if of a good make and well put on, are the best. Winch fittings should be 'anti-friction', avoid the types that fix the reel with a hand nut or screw, and try to get the screw grip as used by Hardy's or the sliding ring type, but see your reel is rigid, or accidents will occur. The grip should be of cork, which is universal to all well-made rods. Agate rings are easily damaged, and the fine crack may escape notice. A perfect rod-ring would be one of rustless steel.

31. *Reels.*—American reels, though grotesque looking, with large winding levers, and wardrobe handles, besides innumerable nuts and screws are none the less popular and cheap. They are the wide drum types, with a line guide which is very useful, and holds a distinct advantage over the popular English makes. This is called 'Level Wind', and the brake to stop over running 'anti back lash'. Most of the reels listed by the Indian dealers (Verona and Manton) are made by Pfluegar, the name familiar to the plug bait enthusiast. I have not used these reels so can offer no comment. The line guide for 'Level Wind' appeals to me very much, as it saves the inevitable 'Crow's nest' caused on the Silex and other direct wind

casting reels but they are all made with a left hand wind. The check can be adjusted to put sufficient strain on, to hook a fish direct.

32. *English Nottingham Type Reels.*—Of these, the Silex is best known, and even though it is expensive, once got into is a treat to use. There are 'Major Silex', 'Super Silex' and 'Sea Silex', and 'Multiple wind Silex', so the choice is wide, for those prepared to pay a big price for a reel. Then there is the 'Easy Cast' reel which is another type, or the 'Asco' built by Albert Smith. These are all on the revolving drum, Nottingham principle, and share the same features in general. The size should be governed by the amount of line needed, and the correct weight to balance the rod.

I have stressed elsewhere, that 150 yards of line for light fishing and 300 yards for the heavy work, is what I recommend, if fish run large.

33. *Stationary Drum Reels.*—Better known as 'Thread Line' or 'Wanless Tackle'. This type of reel is a highly mechanical device, enabling the angler to fish with the lightest of tackle. The drum is stationary except when playing a fish. It is on the 'Malloch' principle, the drum being at right angles to the rod, enabling the line to run off by uncoiling itself off the drum, while casting. A 'flier arm' or 'guide' picks up the line at the end of a cast for a multiple wind in. There is an adjustment to the reel to increase or decrease tension, depending on the other units of the outfit, that is, the line and rod. A correct ratio of balance and tension must be carefully made, for this gear to work effectively. There are many makes, but I regret I am not in a position to make a recommendation, as I have no experience in this line of fishing. In concluding my remarks I am firmly convinced that tackle makers do not fully realise the strain heavy Mahseer fishing puts on the reel, and I can only suggest that if you are buying your stuff at Home, and you cannot convince your tackle maker of the strain on a reel, in the first rush of a Mahseer, hitch your line on to the back of your car, and run it out as fast as you can for two hundred yards then hand him back his reel to look over, and tighten up the loose nuts and screws! but if it has stood this test, and is intact, buy it.

34. *Casting Line.*—For medium-sized fish a fine line with a 14-to 18-pound breaking strain, and fine backing, is all that is necessary, and as to types and makes, the same remarks hold good, as in part (1) of this chapter.

35. *Thread Line.*—'Gut substitute' or 'Ja-Gut' is used, but it is brittle and apt to stiffen up on the drum, and run off in kinks, rather like a cork screw, so that the silk lines, specially made for this tackle are preferable.

36. *Traces.*—As already mentioned, Killin wire is the best for traces, fine or medium, made up with three small swivels, on two 18-inch lengths of wire, for spinning, with longer single lengths and two swivels, for plugs.

For thread line work no trace is required, if the gut substitute is used; with a silk line, a fine gut trace of three feet or so in length is all that is necessary.

For the double-handed fly rod, a gut trace of 6 feet in length with three swivels, is ideal, grading the gut to the size of fish expected. If the river is very rocky and full of snags, the new 'Alasticum' wire is excellent. It is made in finer grades than Killin wire, and down to 5 pounds breaking strain, which is almost invisible in water, and as fine as hair.

37. *Lures.*—Plugs $4\frac{1}{2}$ inches long either jointed or in one piece, make an excellent bait for the short single-handed casting rod, or for rapids where the water is rough and shallow with plenty of 'White Feathers'. They have one great advantage over spoon in this type of water being made of wood they float, and do not grip the water till the line is taut, whereas the spoon sinks until felt by the line, and is consequently frequently hung up in snags.

Spoons.—I fancy the long narrow type $2\frac{1}{2}$ inches long, the back scaled in brass or copper, and dull silver inside, for the usual clear waters of most northern rivers in March and April, but I carry an assortment of 18 or 20 varieties. Follow the general principle of using spoon, and you will not go far wrong, as mentioned in part (1) If you buy ready-made traces and mounted spoons, you will find yourself connecting up in a chain of swivels leading your spoon. The spoon is sold with a large swivel attached to the eye by a brazed ring, the ready-made trace is supplied with either one or two link swivels, to attach to the spoon, so when your spoon is mounted to the trace you have this chain of metal leading the spoon very often longer than the total length of the spoon. Come! Come!! Tackle makers and anglers alike, this can surely be improved upon and the insult to the fish removed!

Fish a spoon as I suggest with the 'Myitkyina' spoon. Thread the spoon and mount on to the link swivel, and you have a strong and tidy job. A spot of red on a spoon, has been given to me as a tip, by an experienced angler, but I have not really given it a trial, and here I reproduce, from the *Field* of 15-8-27, a camou-

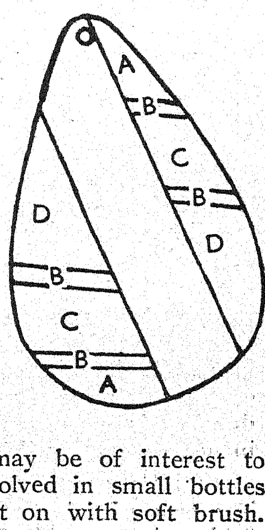


Fig. 14.

A. Vermilion.
B. Yellow Ochre.
C. Burnt Cinnamon.
D. Grass Green.

flaged spoon, by the same angler, which may be of interest to some. 'Sealing wax of various hues, dissolved in small bottles (2 oz. ones) with methylated spirits. Paint on with soft brush.

Paint takes some hours to dry, and longer to become hard; use best English sealing wax. See diagram of camouflaged spoon (fig. 11).

Dead Bait.—Mount dead bait in the manner outlined in part (1), or on the lighter Archer Spinner, to suit the conditions of water and tackle.

III. FLY SPOON AND THE SINGLE-HANDED FLY ROD.

To the majority of anglers this is the essence of sport. It is a relaxation, whereas the big rod is a labour. The 'Gentle Sex', or elderly, can enjoy it with little discomfort or hardship. In fact one can safely say that every angler will fish with a single-handed fly rod, while only a few will set it aside for the big rod, and fewer still will spend a day wielding the heavy rod, if fly spoon work is handy. Besides which, abundant water is available throughout India, to indulge in this form of fishing.

38. *The Rod.*—The best rod you can buy is no extravagance for this light fishing, as the qualities required cannot be had in a cheap one.

If you are stationed near a small river, like the Tochi or Kurram in the N.-W. F. Province, and only small fish are available, then the lightest of rods and tackle will be necessary if you wish to have good sport. A 9-foot rod, suitable for trout, suits this water admirably, because only a small quarter-inch spoon is used, or a large fly; but if the more general conditions of Northern India are your lot, and you are within easy distance of the larger rivers, then a rod will require careful selection. In the chapter for the novice I have stressed the points to look for in a rod for this type of fishing, and here I can only repeat that the fly spoon work in a large river where the general run of fish is 5 to 10 pounds, the 15, 20 and even 30 pounder will quite often take a small spoon, and we find ourselves ill-equipped to deal with these monsters, chiefly because this type of fishing has never been fully understood by the rod maker, and he thinks that a rod which is good enough for a large trout, will more than fit the requirements of the Mahseer. Let us consider the chief differences.

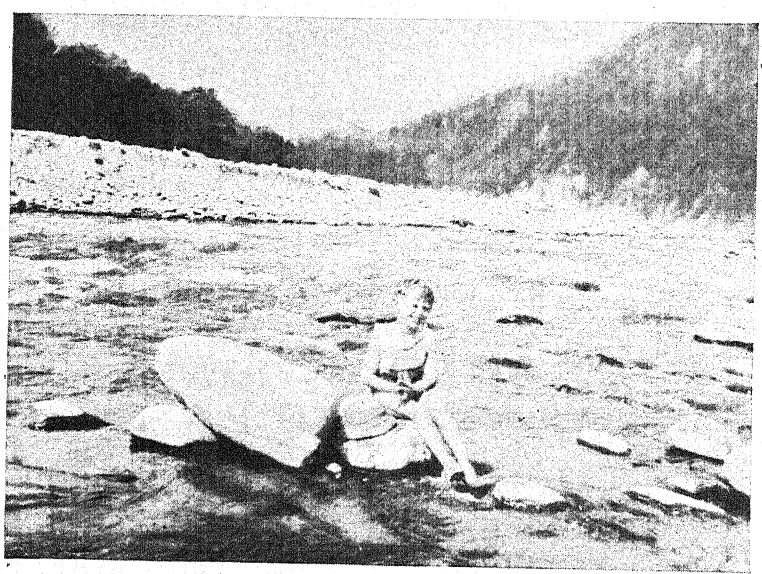
(1) The water is much bigger and stronger than the average English trout stream. See photograph opposite.

(2) The spoon fished in this water has a much greater resistance to offer a rod, than any fly, and both while spinning and at the time of recovery puts a far greater strain on a rod, than a non-spinning lure.

(3) The sun temperature in March or April, or in October, is sometimes as high as 110 degrees in the day (Mad dogs and Englishmen . . .') dropping at night to 75 or 60 degrees. This affects steel centre rods more than the others, but a rod in use for 10 hours a day in this sun temperature is hardly getting the same deal as one in use on an English summer's day.

(4) How many trout over 5 pounds are caught by a single rod, in a season? whereas the average run of mahseer in this type of fishing, is over this figure. See photograph opposite.

Bag of eleven fish weighing eighty-seven pounds, taken on half-inch fly spoon, out of rapid below.



Typical fly spoon water. Note 'White Feathers'.

It would therefore be well to try to convince your tackle dealer of these conditions. After all, if we pay 10 guineas or so for a high-class rod, built for English fishing, it becomes an expensive and poor investment if it is to be replaced every other year or so.

The ideal rod I recommend is a double built split cane, in two pieces for preference, 9 to 10 feet long, as light as it can be made, to recover a half-inch spoon, without straining the point, from a water shute! It should take a reel to hold 150 yards of line, with Agate rings at the end and butt, and with a spare top. But, most important of all it must be as pliable as possible, to assure accuracy in casting, as you will frequently be fishing water, where innumerable boulders will be jutting out, and the spoon must be kept under perfect control, or you will damage it against a rock or get hung up, besides which a pliable rod is imperative to hook and hold a fish with light tackle.

I do not think these simple requirements are beyond the scope of the modern rod builder, nor do I see why they should not be turned out, inside the price charged for superior dry fly rods. If one of the tackle dealers out here would be enterprising enough to get a rod built on these principles, I am convinced sales would be assured.

39. *Reels.*—Any good quality fly reel, free from levers, etc. to foul the line, with a capacity to take 150 yards of fine line, and with an adjustable check strong enough to hook a fish off its own, is good enough. For the lighter fishing any ordinary trout reel will suffice.

40. *Lines.*—Tapered fly lines may be used with the light tackle, if a quarter-inch spoon is the lure, but the ordinary braided line mentioned in part (2) of this chapter, fits all the requirements for either large or small fish.

41. *Traces.*—For small fish 2X gut is good enough. The best gut is the cheapest in the long run. I have used drawn-gut casts and traces for three or four seasons, and only discarded them because they had frayed, as a result of being rubbed against rocks while playing fish. Keep gut in flannel when not in use, and in a dark air-tight box, and it will keep indefinitely. For the heavier type of fishing use fine, medium, or stout Trout size gut traces. If you have your traces made up for you, insist on 5 to 6 feet for length, and the finest swivels you can get.

42. *Treatment of gut and how to tie traces.*—I give the method I use both for soaking gut and tying traces with every confidence. I have traces still in use that I made 4 years ago, with gut that is 8 years old. If you take the trouble to follow these instructions you will have the same good results.

It is most important to soak gut that has been lying by for long periods gradually. Damp a flannel rag 10×10 in. in lukewarm water, fold it into two and lay the gut strands in it, then fold into four and leave overnight, cover it over with a finger bowl, this helps to retain the moisture in dry weather. After the gut has soaked overnight it can be removed from the damp flannel and put into a bowl of lukewarm water. It should by this time be soft and ready to tie.

43. *How to tie a cast.*—(1) Test and grade the strands of gut (drawn gut is graded), take two strands at a time out of the water and tie together; put these back into the water, and tie the next two strands and so on until the jointed lengths are also tied together, or attached to swivels, cut the ends close and you have the job finished. Dry the trace gradually in a moist flannel, and you will have eliminated all risks of the trace letting you down.

44. *Knots for traces.*—There are several knots used for tying gut, I will give three of the better known, and in order of my personal choice.

(1) The Lovers Knot.—Place the two strands together as in fig. 15 *a* with the ends lying in opposite directions, make a single overhand knot at each end, then give each end a double turn through its own ring and over the gut strand, draw first one end moderately close, then the other. Each should fall into two neat coils around the other, bring these coils close together, then pull tight and up against each other pull the ends and cut away.

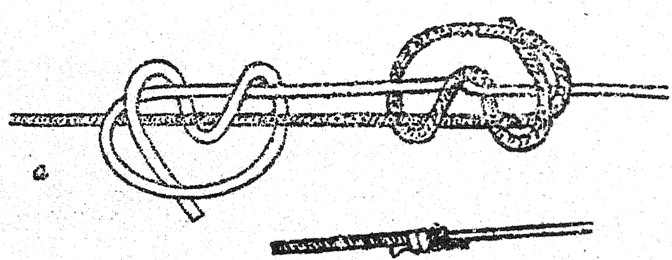


Fig. 15 *a*.

(2) Buffer Knot.—This is a simple but serviceable knot, easy to follow and tie. Make two simple overhand knots, one in each strand, and pull close leaving enough room to thread a strand of gut through thread each through the other pull tight and draw the knots together; give the short ends a further pull, and cut away (fig. 15 *b*).

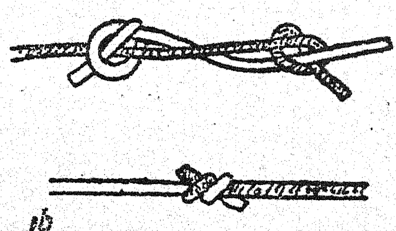


Fig. 15 *b*.

(3) The Barrel or Blood Knot.—For those who wish to be expert and who like knots for the fun of tying them, this is the tidy and finished job, though sometimes tedious. Hold the two strands together and turn one right handed and the other left handed; with the same hold thread the ends back through the centre and with the

coils and ends held with the lips pull tight the strand and ends. (fig. 15 *c*).

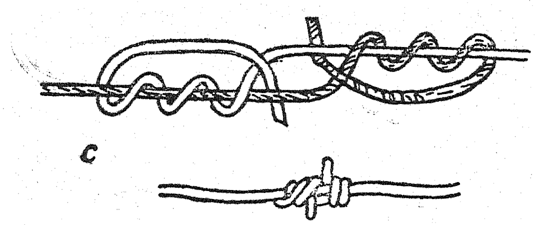


Fig. 15 *c*.

45. *Knots for attaching gut to swivels.*—I always use a simple loop, threaded through the eye of the swivel, then pass over the other end and pull tight. This gives extra strength at joins and eliminates the swivel cutting through the gut, but there are other knots that can be used. I give three of the most popular though I personally recommend the simple loop as the most reliable. (See fig. 16 *a, b, c*).

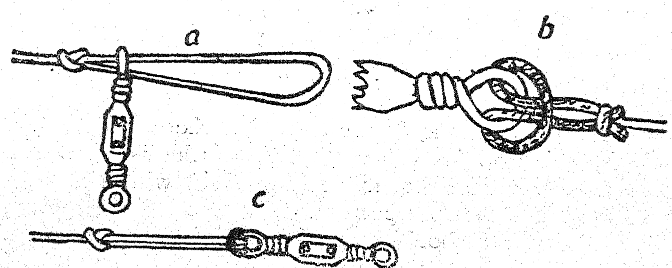


Fig. 16 *a, b, c*.

(1) Double the end of gut and make a simple knot, pull the loop and small end tight and cut away (fig. 17 *a*).

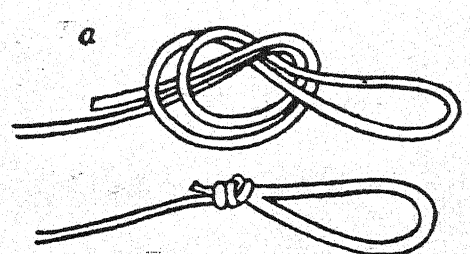


Fig. 17 *a*.

(2) Another way of making a loop is to tie a single overhand loop in the gut, turn the shorter end back and thread through the knot.

Then make an overhand loop over the strand with the short end, draw together and pull tight. Cut away ends (fig. 17 *b*).

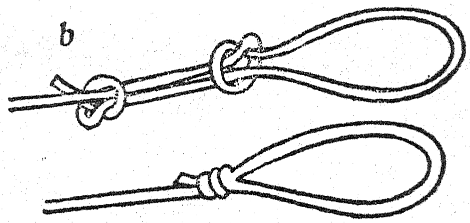


Fig. 17 *c*.

(3) Pass the end of the gut through the eye of the swivel, then bring it back and make an overhead knot, give the end a loop under the main strand, pull tight and cut close (fig. 17 *c*).

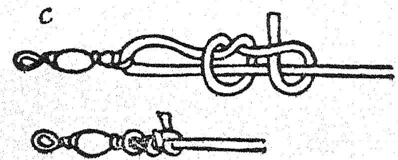


Fig. 17 *b*.

'Alasticum' is finer and stronger, for those who prefer wire. Gut substitute is also fancied, so that the choice is wide. I personally recommend natural gut, made up oneself, with a large gut loop at the end to mount the spoon or bait, and with two very small swivels. One swivel should be at the end of the trace to which the line is tied, and one in the middle, i.e. from either end. The fly spoon provides the third swivel fixed to the loop of the trace (fig. 18).

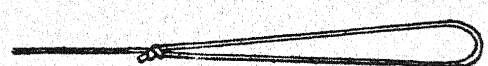


Fig. 18.

In making up wire traces follow the same procedure, only instead of the loop, attach a small Hardy swivel to the end, to thread on to the fly spoon by split ring (fig. 19).

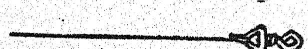


Fig. 19.

46. *Lures.*—We have a big assortment of lures from which to select. Spoons of varied kinds, insects, flies, feather lures of the Evelyn types, Celluloid Minnows, Heddon Spooks on the plug principle, besides the small bait mounts for dead bait, all of which can be used on the fly rod. I will take these in order or in groups, so as

not to make this note as confusing as a tackle catalogue; for every bait therein is advertised as excellent. Let us take for instance the text below two such baits from Manton's catalogue.

Bar Spoon.—'Fished as a fly we know of no more deadly lure for small Mahseer'.

Mother-o'-Pearl Spoon.—'Many a sulky fish can be raised to this spoon that would not raise to anything else'.

The Fly Spoon.—Fly spoons vary in size from one inch to a quarter of that size, and are built heavy, medium and light and coloured in the usual copper, brass and silver, or a combination of these colours. The Mother-o'-Pearl spoon is very popular for cloudy water. The spoons themselves are made with either a flying or stationary mount, as in the Bar spoon.

Let me draw your attention, first of all, to Manton's catalogue, where a large assortment of spoons are excellently illustrated, and I also call your attention to the method generally used for mounting spoons. You will see that only in one instance is the swivel lead small and tidy, this is on Hardy's fly spoon. On the other makes of spoons large ugly swivels are mounted. Surely with the gin-clear water, which is so general with the Indian rivers, we should be particularly careful to avoid this. I give a simple but effective way of mounting spoon on to either gut or wire, in part (2) of this chapter, which will be a great improvement; and which has the better chance of attracting fish? (fig. 20 *a* and *b*).

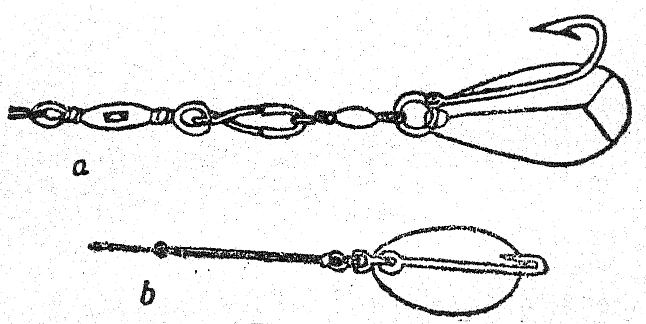


Fig. 20 *a*, *b*.

If you applied the first method to trout at Home, you would be considered as raving mad, yet quite a few people will put this to a Mahseer, in water gin clear; quite apart from the appearance of this swivel chain, think of the vibrations it must set up in opposition to the true spin of the spoon. All that are required are some Hardy's swivels, some good split rings, hooks and spoons.

Split Rings.—Although I deprecate the use of split rings, with heavy tackle, they are excellent for this type of fishing, where they are not subjected to heavy strain, and will stand up to the biggest fish taken on this light tackle, if kept free from rust and well oiled.

In offering advice in the choice of fly spoons, it largely depends on the rod. First find the best weight of spoon to suit your rod, then have an assortment made up in the different shapes and colours to suit your fancy. A flat spoon will tax the rod less while spinning

than a hog backed one, so you can increase or decrease the size to suit the shape. I myself fancy the long narrow type for reasons already mentioned, and the semi hog backed type like Hardy's, with a flying mount, as I think it has a better chance of hooking and gives better deception than a bar spoon, when the mount is stationary. I use copper and silver, one as much as the other, depending on the water.

In rivers with dark coloured boulders, I like a spoon with the copper almost black inside, and silver out. In fairly deep water I like silver; and in fast shallow runs, and lightly coloured rocks gold and silver; but there is little choice in any of them. I am not in favour of trebles for fly spoon as for one thing, if they are strong enough, they are too heavy, and if light not strong enough. I am a great believer in a single flying mount as illustrated on the narrow spoon I recommend. I do not think small trebles are as effective or hook as well as a single hook.

The Bar Spoon revolves around the bar through the spoon, and is preferred by some to the ordinary type, but I cannot say I have had much success with it. The 'Lindsay' spoon sold by Verona is on this principle. Mother-o'-Pearl is very light and pretty in the water, and very good in some rivers. I have had success with it in coloured water.

I produce here four types of fly spoons I fancy. See fig. 21 *a, b, c, d.*

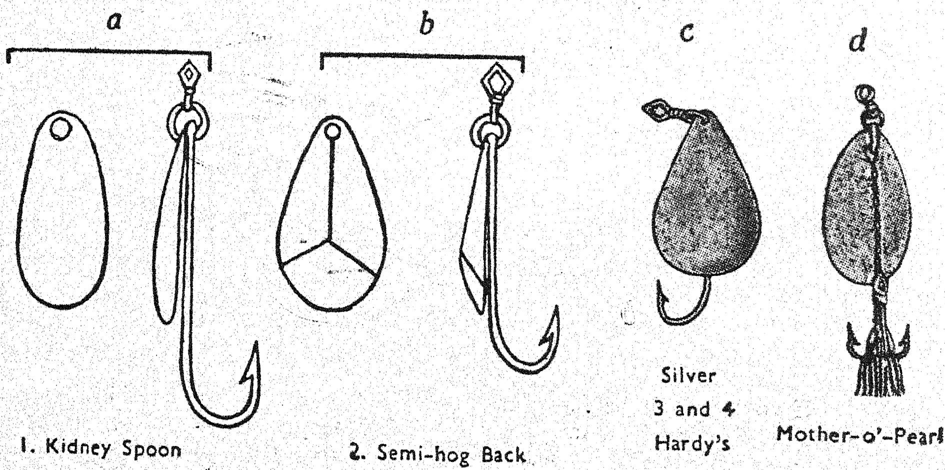


Fig. 21 *a, b, c, d.*

No. 1 I like best, and have found most successful in all types of water.

No. 2 is semi-hog backed.

Nos. 3 and 4 are both made by Hardy, and are excellently mounted.

Remember when selecting spoons to study the mounts. Single hooks not trebles on fly spoons. Small swivels and small rings.

Hardy's Mother-o'-Pearl spoon is mounted with a treble, but

a strong single hook, on so brittle a substance as Mother-o'-Pearl is apt to chip or crack it while casting.

Colours.—The best colours are a combination of gold and silver, or copper and silver, or all silver, just whichever suits local conditions best. A tag of red cotton on the end of a hook is sometimes effective.

Insect Lures (*Artificial*), made up as spiders, beetles, etc., I regret to say I have no experience with; but they are attached to a gut cast and used as a fly. They might be good in lakes or in pools. I do not think they are as effective in rapids as spoon.

Fly or Feathered Lures.—These will take quite well in slow runs, and give excellent sport where water is slow and running among large boulders. I have not found either as effective as fly spoon in runs.

Celluloid Minnows or Spooks on the 'plug bait' principles are well worth trying if other baits fail, but I do not think any of these baits have the range or attracting powers of the spoon, for the simple reason that they have not the resistance.

Allcock's Minnow Mounts.—These are excellent if a small enough fish can be had, and one that will not break up with switching in and out of the water. It is deadly in all water.

I will conclude this chapter with a few general accessories that should be part of the kit carried while fishing. But do not put all your eggs in one basket, keep some in camp, some in your bag with the attendant, and the few spoons, lures, etc. necessary for changes, on your person.

Spare reel and line.

A small tin box with penknife, a pair of scissors, baiting needle, silk and wide-eyed sewing needle, and spare attachment links and swivels, pair of wire cutting pliers, and a spool of Killin wire, for mounting dead bait. A small watchmaker's hand vice should also be included.

Weights.—Carry some spare in assorted sizes to replace losses.

Spoons and Mounts.—Carry these in one or two suitable sized tins, to fix to traces as suggested in part (1) of this chapter.

Spinners.—Have two or three spare Crocodile or other fish mounts handy in different sizes.

Traces.—Carry a book or tin with a couple of spare wire traces, and gut traces, in case of breaks.

Weighing Machine.—A good scale graduated to 60 pounds will fit all requirements.

A note book, pencil and camera are also valuable for recording good water and fish.

A roll of sticking plaster and an iodine pencil are handy to have as tosses and cuts frequently occur while wading.

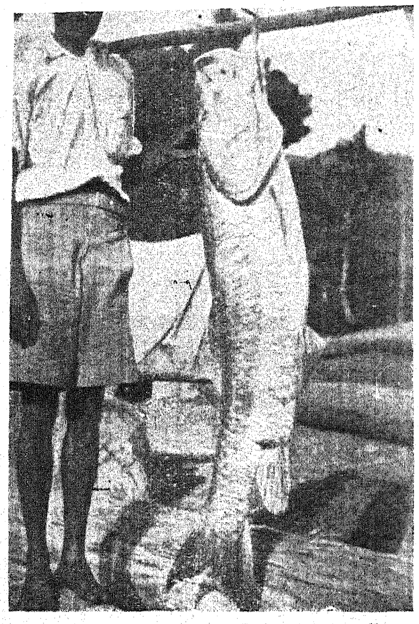
Carry on your person, a turn screw to fit all screws on your reel and a small tin box to fit conveniently into a pocket with some spare fly spoons and other lures, so that you can change from one to another while fishing, if necessary.

47.—*List of tackle dealers*.—I give, in conclusion, a list of a few of the tackle makers and dealers known to me. There are many others of course, but if you get an Angler's guide or price list from

one or more of those mentioned, you will be able to understand and follow easily the text of this chapter.

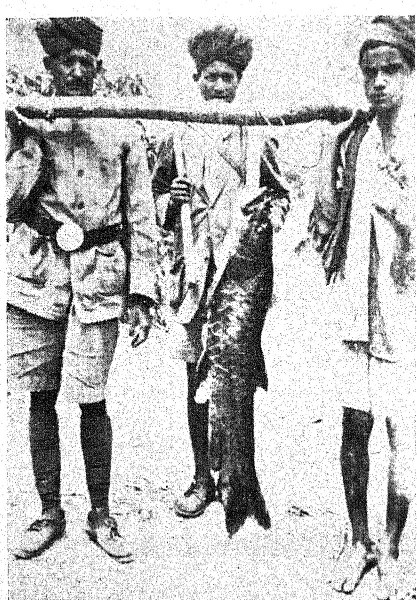
(1) The Army & Navy Stores, Bombay.
(2) A. E. Verona, 153, Dharamtolla Street, Calcutta.
(2) Manton & Co., Old Court House Street, Calcutta, and New Delhi.
(3) Mrs. Allen, Kilmore, Dehra Dun, U.P.
(4) Oakes & Co., Madras.
(4) Wilson & Co., Chemists, Rawalpindi and Murree.
(5) Barton & Co., Ootacamund.
(6) Watson & Co., Rangoon.

4 COMMON TYPES OF MAHSEER TAKEN IN MOST NORTH INDIAN RIVERS.

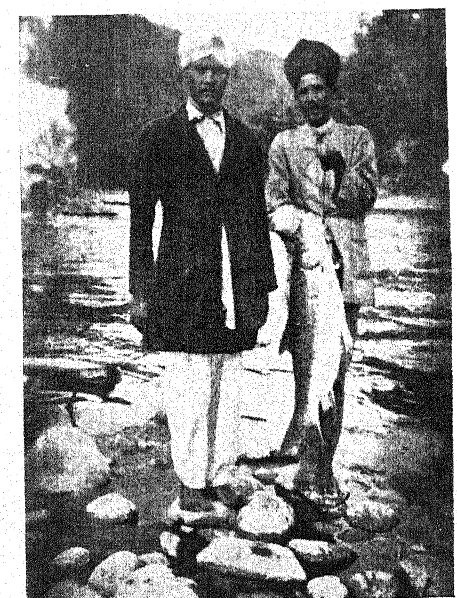


(1) A typical 'Golden Mahseer', 50 lbs.
Barbus (*Tor*) *putitora* (Hamilton).

(2) Thick-lipped 'Mahseer', 52 lbs.
Barbus (*Tor*) *putitora* (Hamilton)
With hypertrophied lips.



(3) The 'Black Mahseer'. 26 lbs.
Barbus (*Tor*) *putitora* (Hamilton)
Melanic Form.



(4) Short gilled, deep-bodied type, 25 lbs.
Barbus (*Tor*) *tor* (Hamilton).

Note.—Dr. Hora's work on the Game Fishes of India has revealed that there is no reason to believe that 1, 2 and 3 are separate forms.

Chapter VI.

FISHING FOR MAHSEER.

'Wild and wide are my borders, stern as death is my sway,
'And I wait for the men who will win me—and I will not be won in a day;
'And I will not be won by weakling, subtle, suave and mild,
'But by men with the hearts of Vikings, and the simple faith of a child;
'Desperate, strong and resistless, unthrottled by fear or defeat,
'Them will I gild with my treasure, them will I glut with my meal.'

R. S.

The attributes of the good angler (1), The Mahseer's idiosyncrasies (2), Size no indication of age (3), Diet of Mahseer (4), Power of jaw (5), Spawning (6), Method of taking bait (7), Spoon versus other lures (8), Capt. F. Stonham's Note on Plub bait (9), Spoon bait and scale effect (10), Hen fish attains greater size (11), Spinning for Mahseer (12), Where to look for Mahseer (rapids) (13), Sketch of good water lettered (14), Pools (15), How to work water and the cast (16), Known water (17), How Mahseer rise (18), Monotony of one bait (19), Point of rod (20), Selection of water (21), Lacey's log of good and bad days with my summary (22), Wade cautiously (23), The element of luck (24), Water and temperature (25), Following in a boat (26).

Other Methods of Fishing for Mahseer (27), The fly and fishing with fly (28), Gram fishing for Mahseer (29), Method of Fishing (30), Gram for bait (31), Hooks (32), Cast lines (33), Tackle (34), Other tips (35), Paste fishing for Mahseer (36), Baiting with paste (37), Points relating to heavy fishing (38).

THE ATTRIBUTES OF THE GOOD ANGLER.

1. The patience of Job; the eye and observance of the eagle; the perseverance of the termite; the hands of an artificer; the touch of a musician; the temper of a saint; and, above all, an unsatiable ambition to learn.

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2. *The Mahseer's idiosyncrasies.* Before dealing with the actual fishing, it will be as well to consider a few important points about the mahseer which either directly or indirectly influence the methods to be adopted. The mahseer has certain idiosyncrasies, which are not in conformity with the salmon or trout. He likes clear water, in fact the clearer the better; the rougher and whiter the more does he love it; thunder and rain may or may not subdue his capricious appetite. They are taken in the winter, summer, spring and autumn. His size is no indication of his wants, the little chap of 1 pound or

less will ambitiously take a 4-inch spoon, with the same readiness as the monster of 30 or 40 pounds takes a half-inch fly spoon; and most important of all when considering mahseer fishing, we have to bear in mind a fish ranging from a few ounces to one of 5 score pounds or more.

True, that in most rivers his size can be ascertained fairly accurately, but this is by no means the case with most of the larger rivers, which have the monsters mingled with the game little fellows of a few pounds. Few anglers who have fished the larger rivers have not experienced getting into one of these iron-clads while indulging in the gentle art with 9 ft. fly rod and fine gut casts, and many must be the recollections and regrets of good fish lost.

3. *Size no indication of age.* Fishing for large and small mahseer are things apart, and call for methods as widely separated as those used for the monsters of the sea of 100 pounds or more, with those employed for the game little trout of a pound or more, in a stream barely 30 feet across. The size of a mahseer is not necessarily any indication of age. A ten-year old fish in a small stream may only be 5 pounds, whereas a ten-year old fish in a big river may grow to 20 pounds or more. Like the salmon in Britain, the mahseer is the aristocrat of the Indian waters. His chief characteristic is the first rush. As soon as he is hooked he may go 50 or 200 yards without stopping, depending on his size and the strength of the water. His choice for rapids and broken water makes him a strong fish, this is further illustrated by his area of fin. The mahseer, like most of the Indian fish, is not very tasty, and is inferior to the Butchwa and Murral; some people, however, prefer his flesh to any other.

4. *Diet of Mahseer.* He is a fish with a variety of tastes. He will take small fish with the same readiness as he will worm and paste; a fig or berry on the surface; or a frog on the bottom; leaves and scum in a still backwater; small birds or birds' eggs; lizards, locusts, flying ants, weeds and small fish. He will even de-tick an animal lying in water. The best and most convenient bait is the artificial spoon, which should always be the first course on the menu when fishing for him, unless, of course, it is known that he will not touch spinning bait, as is the case in some rivers. Persevere with dead or live bait and if these two produce no luck, then try baiting a rapid with paste balls and fish with a similarly baited hook, the same applies to gram or fig berries. I have known of mahseer waiting under bridges over the Ganges canal near Hardwar, for young martins to fall out of their nests. A 40-pound fish was caught in this way. Eggs we will leave aside, because of the difficulty in mounting; flies, locusts, green caterpillars, etc., are easily fished with, and well known.

5. *Power of Jaw.* It is difficult to realise the crushing power of a mahseer. I have had a 3-inch copper spoon (one-eighth of an inch thick), and the treble crushed in a more convincing manner than if it were done in a vice. His teeth are located in the throat well back, and inlaid in rolls of muscle. Cutting out the teeth, convinces one of where the strength lies.

I am inclined to believe that the damage is done by the teeth

and not in the mouth chamber, as is commonly supposed. I am opposed to Thomas in this, but in defence can only quote two instances. In the first, I found the tail treble crushed, while the fish was hooked by the top treble of my mount inside the mouth. The throat was cut and bleeding, and the crushed treble had on it the white leathery lining of the throat. This was an 11-pound fish.

The second instance was when I found the tail treble broken off and in the throat, the fish being hooked by the top treble. This was a 21-pound mahseer, the treble was one of Hardy's improved types, and was bent out of shape. If the damage was done by the lips or in the mouth chamber, as stated by Thomas, and generally believed, broken and bruised fingers would be common among fishermen and anglers: whereas the professional fisherman will readily put his hand down into the mouth of a fish (mahseer) to extricate a hook, which he would hardly do if these powers were in the mouth. I have never myself experienced a bite or met anyone who had. A horny pad on the roof or floor or the mouth would surely be provided by nature, were these phenomenal powers in the mouth. Dr. S. L. Hora writes to me on the subjects as follows:—

'In the case of Cyprinoid fishes, the pharyngeal teeth are developed as a compensation for the loss of the teeth in jaws, and for this reason they perform all the functions of the ordinary teeth of fishes.' (See *B. N. H. Journal* xli, pp. 790-94.)

6. *Spawning*. Spawning is done two or three times in the year, chiefly during the monsoon, and just before, when the snow water comes down.

In April 1928 at the confluence of the Mali and N'Mai river in Burma, I took, with a friend, nearly 1,200 pounds of fish, and the majority were full of spawn.

Different rivers though have different periods. Spring-fed rivers are probably later and not until the monsoon sets in properly. Fish then work up the smaller streams, and deposit their eggs. Mahseer are not always edible during this period, and cases of poisoning or colic have been recorded.

Dr. Hamid Khan, Ph.D. (Cantab), writing in the *B.N.H.S. Journal*, Vol. xli, No. 1 dated August 1939, under the heading 'Study of the sex organs of Mahseer', deals fully with his collection and study over most of the Punjab rivers of mahseer throughout the year, and his conclusions, based on careful observation, would certainly indicate that in the Punjab anyway, mahseer have been found gravid three times in the year. His own words sum up the position fairly conclusively:—

'There is thus strong evidence to show that the mahseer spawns more than once during the year. Most of the Indian Carps, such as *Labeo rohita, Labeo calbasu, Cirrhina mrigala, Catla catla* and others spawn in June and July when the rivers are flooded with the monsoon rains and lay their eggs in one batch once in the year (Hamid Khan, 1924). The Mahseer, however, as a study of its sex organs reveals, seems to spawn *firstly*, in winter, in January and February, *secondly*, in May and June, when the snow melts and the rivers are swollen and *thirdly*, from July to September, when the rivers are flooded with the monsoon rains. It is for this very reason that fry of the Mahseer of all ages is seen during the whole of the year in the hill streams of Kangra, Hoshiarpur, Jhelum and Rawalpindi Districts.

'There is, however, hardly any evidence to corroborate the views of Thomas (1897) that the Mahseer lays its eggs in batches, "just as a fowl lays an egg a day for many days." The simile does not appear to be appropriate, as in the case of the Mahseer all the eggs contained in the ovaries seem to be laid at the spawning time and the ovaries become empty. At the approach of the next spawning season the ova reappear, increase in size, swell the ovaries and are laid again. It may, therefore, be said that the Mahseer does not lay its eggs in three batches, but that it spawns three times in the year, and that all the eggs in the ovaries are laid in each spawning season.'

This might well be taken to represent the conditions of the other river systems in India, which are snow fed, or such spring-fed rivers that join these larger rivers in the hills. The conditions in the case of the smaller rivers that are not influenced by snow water, and have to flow long distances over the plains before joining these rivers, will need further elucidation, and I think some variation may be found to exist.

Though the mahseer is essentially a bottom feeder, his special choice being among rocks for stone loach, and shell fish, he will take below and on the surface, whatever dainty morsel is in season. I have seen them under a fig tree, almost jump out of the water to take a fig as it touched the surface; so when fishing for him, exploit all means and depths before abandoning your efforts with the poor assurance that fish are not on the feed.

7. *Method of taking bait.* From what I have been able to study of the Mahseer tâking a spoon or small fish, they will either surprise it from below, or follow from underneath turning over the bait as they take it.

That small fish come to the surface, as soon as a big fellow is signalled, partly substantiates this. I have also seen a fish take up a position in a small cove and dash out at passing fish with the same up and round movement; this also partly accounts for fish getting foul-hooked so often in the face, the hook catching them as they pass over the spinning bait.

Whether I am right or wrong, it was my belief in this that caused me to devise a special form of mount,—a small treble on top and a larger tail·treble. The head treble I find, invariably hooks the fish, if it is hooked outside the mouth. I think also, that a mahseer takes or tries to take a bait head first, as a snake takes a frog or rat. This would also account for the smaller hook fouling the fish outside the mouth, the trace obstructs the fish taking the bait from the front end, and in failing as he turns over it, he is hooked in the cheek. I have often experienced fouling a fish with the hook shaft running away from the mouth, and the tail hook wrapped under and fast under the jaw.

8. *Spoon versus other lures.* Before we consider bait, let us first of all be agreed on the object of the bait. It is to attract and deceive. I have dealt in a previous chapter on the fish's senses, as I understand them, that is that he is attracted to the lure by the vibrations set up, that he has detective rather than sharp vision, as a secondary organ to his feeling, and to these two senses we may add taste or smell, as he is well equipped with barbels.

How does the spoon fit these two points of attracting and deceiving, as compared to dead bait, plug, spinners, etc.?

The spoon of the Myitkyina type, certainly sets up more pressure waves than a dead bait, as it spins faster, and is not as well adapted in shape to the water as the dead bait (Fish), so setting up greater pressure waves of a kind, the roughly hewn scale effect, on the convex side, must give additional aid in the water much as the teeth of a saw, in wood. The plug has a greater displacement than the large spoon, but has not the action or disturbing factor, in the water. The plug's superficial area, though slightly larger than that of the spoon, has considerably less bearing surface, so that the action in the water is reduced. The whole surface area of the spoon grips the water and revolves, whereas the diving shield on a plug is only half an inch square approximately, and in the jointed types the rear section has about as much again. Spinners have even less than the plug. So that in 'Attracting', I am inclined to the belief that the spoon covers a greater range, and would register to a fish at greater distances than the other bait under consideration.

We now come to the second point, 'Deceiving'. Here the other two senses of the fish come into play to a greater extent. In a close-up vision of a spoon revolving, a fish is able to see no more than we can, probably less, as the sharpest perspective the eye can take in is, I believe, at one-fifth of a second. So that a spoon revolving fast, retains its deceptiveness to the eye of a fish, though the chemical senses of taste or smell would be to the fish's advantage and consequently against the spoon; but in the case of the plug the main portion is stationary in the sense that the body maintains the upright position with the hooks below, and consequently does not deceive the eye to the same extent that a fast revolving spoon would, the detection of the chemical senses is the same in both cases, but the hooks on a plug are not revolving but dangling from the body of the plug, and would show up if carefully scrutinised, and then as we must suppose a mahseer cannot recognise a treble hook as such, he may reasonably be expected to take it to be a pectoral fin—if he is as inquisitive as all that!

The hooks on a spoon revolve with it. The spinner shares the advantage of the spoon in moving around its own axis, though not as fast. So that on the points considered so far, the spoon would seem to have an advantage over the plug and spinner, and the spinner a slight advantage over the plug, but the important point of how the action of each, in water, is conveyed to a fish, remains unsolved, and it is probably that in this the plug has its main advantage, though this is only surmise on my part.

As has been pointed out previously fish are near sighted, so in fast water a mahseer has not much time to examine the bait, therefore each of these would give results; but in the slower water of pools and runs a fish is able to be more fastidious, and this is why dead bait is so much more killing than the other baits, as the chemical senses must be the fish's convincing factor, unless of course there is competition in a shoal, when the boldest fish takes first. So that considering the spinning baits on these lines, I am left convinced that the spoon is the best lure, unless of course we know the fish of a particular river will not take it. But for the supporter

of the Plug Bait, I reproduce a note by Capt. Franklyn Stonham, I.M.S., who has very definite views on the merits of this lure, based on the excellent results he has had in the Doon and other rivers.

Plug baits for Mahseer by Captain Franklynn Stonham, I.M.S.

9. 'There is now little doubt that the plug has come to stay as a favourite bait for mahseer and other Indian fish. Not only has it "caught on" in the river round the Dehra Dun district but I have had reports of its success in Ceylon, and in other parts of India. Its advantages should be at once obvious. Its action in the water is the closest imitation of a genuine fish that has as yet been devised, and as the majority of plugs are lighter than water and only dive when pulled, they are seldom lost. The wriggling action in the water effectively disguises the hooks which are sent into vibrations, and the fact that they do not "spin" or rotate renders anti-kinking devices superfluous and besides there is very much less wear on the lines.

'There are many makes of plug to be had, many types, and many finishes. For mahseer I find the finish is of minor importance provided that it is a natural scale finish. Those painted in more freakish manner such as white body and red head do not appear so attractive and to be a little dogmatic I may state that what I have found the best colours are Natural Perch, Natural Pike, Golden Shiner, Red side Scale, and Green mullet, the latter two being my favourites. I have tried almost every conceivable type of plug and both from my own experience and that of my angling colleagues I consider that the "Pfluger" Pal-o-mine stands supreme. It is beautifully finished, the hooks can be easily changed or renewed, a very important point, and it darts through the water with a most convincing slight wriggle, close to the surface, and exactly mimics a *chilwa*. Remember that when mahseer are "taking" they are feeding at or just below the surface, and the old motto slow and deep for big ones in no way is generally applicable to mahseer fishing.[1] Next to the excellent products of Pfluger I would place the Heddon Company's "River Runt". This has the same advantages of Pfluger's Pal-o-mine, and is even more beautifully finished and can be had of translucent material. However, the diving plane is difficult and they have some tendency occasionally to come out of the water. I do not think that the jointed plugs have much advantage over the straight ones except in quieter water and if they are not kept dry after use there is a slight though definite tendency for the wood from which they are made to crack. I almost invariably use the largest size, i.e. the $4\frac{1}{2}$ inch Pal-o-mine as small fish are not averse to tacking so large a bait, and I have taken mahseer as small as one pound on them, and besides they are easier to cast being heavier. The sinking type of plug such as the "Live Wire", "Neverfail" and "T. N. T." minnows are good for occasional use in

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[1] I am afraid I cannot hold with this view, and unless he fishes deep in some of the great rivers and pools of Burma and Assam, the angler would be destined to failure.

deep still water, when the fish are not rising. They have all occasionally brought me success.

'A most important feature about plugs is the hooks. Those fitted to most American plugs are not quite strong enough to be relied upon for heavy mahseer, and after trying many varieties I find the best type to be those put up by Pflugers as "Extra strength" size 10 tinned trebles. The conventional mahseer treble is not such a good shape and unnecessarily heavy. They upset the balance and movement of the plug and besides their absolute rigidity results in a greater tendency for the plug to lever them out of the mahseer's fleshy mouth. The hooks fitted to some plugs of English manufacturers are far too small and besides the British firms so far do not seem to get the hang of plugs at all.

'Plugs can be fished on any kind of spinning tackle, but their main problem is their extreme lightness, as the largest size only weighs 5/8—3/4 oz. according to the type used. If the conventional type of heavy spinning tackle is employed a weight may have to be added to the trace which is not desirable as it has a tendency to make the bait go too deep and it interferes with its action, besides the risk of fouling the plug on the bottom, especially if one has an overrun and losing it. This practically never occurs if no lead is used. Overruns are fairly frequent if one attempts to cast light baits with heavy tackle. I have now completely abandoned the two handed rod in favour of what is known as the American bait Casting rod. These rods are conventionally about 5-5½ feet long and a standard 5 ft. rod weighs only about 5 ozs. For all ordinary mahseer fishing such a rod is quite heavy enough and I have landed mahseer up to 45 lbs. quite easily on a 5 oz. rod. I prefer however to use one a little more powerful when I expect heavy fish so that I can play them hard as I usually like to play the fish against the maximum amount of drag I think the tackle will stand. For that reason I use a rod of 6½ ozs. to 7 ozs. 5½ ft. long which is, I think, perfectly adequate to land any mahseer. Using a rod weighing 6 ozs. 1 dram I once landed a 50-lb. fish in less than twenty minutes in heavy water.[1] For heavy mahseer I advocate the use of a "Norka" reel carrying 200 yards of 24 lb. test braided silk line such as "Lignum Vitae" or a "Nonpareil", and for lighter fishing I recommend the "Supreme" reel with 200 yards of 12 lb. test line.[2] The trace should be one ft. of fine cabled steel or phosphor bronze wire with a "Cooper" or "Stronghold" snap, which works like a safety pin, to attach the bait, and a "Lyons" ball bearing swivel to attach the line to. The ball bearing swivel will always revolve no matter how hard it is pulled on, and though not essential for plugs it allows spoons or spinning baits to be employed as well if one wishes, and only one such swivel is required. Solid wires are not to be recommended for traces as they may very easily break

[1] I think an average on fish over 20 lbs. would break this theory, and toy tackle would be next to useless for negotiating the really heavy water in most of the larger rivers in India and Burma.

[2] I have quoted instances in this book, where 200 yds. of line has proved insufficient for the large fish, and 150 for light and medium fishing.

if kinked, though fine stainless piano wire exhibits this tendency to only a minor degree, if one wishes to make up one's own traces. Solid wire can be twisted to attach it to swivels, but cable wire must be soldered, taking precautions not to let the wire become overheated by too hot a soldering iron.

'The advantages of one-handed casting are numerous. The tackle being very light in proportion to its strength, may be used all day without the slightest fatigue, which is a very decided advantage in hot weather. If one becomes proficient in over-head casting it is extraordinarily accurate, and using the reels mentioned above casts of thirty to sixty yards can be made with a little practice. The reels are multiplying and the plugs can be moved at any speed, and can be even cast upstream and worked down with a strong current. The multiplying action saves much of one's energy and is of the utmost advantage in playing a fish as slack line can be recovered almost immediately. Braking is done by thumbing the spool and is semi-automatic as a sudden rush on the part of the fish pulls the rod down and moves the reel away from the thumb, and besides this thumb pressure can be finely graded. Another very great advantage is that the rod can be held and the fish can be played *entirely with one hand,* leaving the other hand free to assist oneself climbing rough banks, or wading strong water without the aid of a cooly, and this feature is also an advantage if one wishes to gaff the fish oneself.

'This type of tackle has been frequently criticised because it limits the length of the trace. My experience leads me to the conclusion that there is not the slightest disadvantage in a one-foot trace.[1] One only needs the trace in the event of a fish with teeth, such as a goonch, being hooked, and to obviate the risk of the hook points accidentally fraying the line. Otherwise it is open to question if a trace is necessary at all, as the dull black colour of the two lines mentioned above makes them no less invisible than any ordinary wire trace. Another criticism is that these short rods do not allow the line to be lifted over bushes. This argument does not bear closer examination as the rod can be held high above the head and the fish played, and besides this, there seldom are any bushes close to a mahseer stream.[2] In fact, there is often no vegetation within several hundred yards of the water except when it rises during the monsoon. One disadvantage is that weights of over 1 oz. such as a chilwa on a spinning mount are not easily cast with one hand as neither the rod nor one's muscles will stand up to the strain, and for such heavy baits a two-handed rod is better. Still when one is accustomed to plugs one seldom wants to use chilwa.

'Lastly, let us consider the reel. For this style of fishing the level wind anti-backlash multiplying reel is to be preferred. They are all American and many makes and types may be obtained. The only British example I know of, though an excellent reel, has too

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[1] In this connection I have expressed my views freely elsewhere.

[2] I think this view is also a questionable one; in some rivers certainly.

small a line capacity to commend its use for anything but light mahseer fishing. These reels are entirely automatic and do not overrun but they are complicated and are easily put out of gear by careless use. They require constant attention to give good service. The level wind mechanism is the most vulnerable part in dusty India and must be frequently oiled and cleaned. Still if one is careful with one's tackle they give long hard service. On all the better ones the bearings etc. are adjustable for wear and the level wind pawl is supplied in duplicate and this spare is built into the reel, other spare parts are standardised and can be obtained from the makers if ever required. If one buys one of the better types and looks after it, will give almost unlimited trouble—free service. I have used a Norka solidly for four seasons and it is still as good as new. It casts baits from ½-1 oz. admirably, but the smaller reels work well and give satisfactory length casting even less than ¼ oz. provided not too heavy line is used.

'In conclusion I may state that in my opinion the heavy two-handed rod and many of the methods now employed in mahseer angling are doomed to early obsolescence, and the short light rod and light tackle will appeal more strongly to anglers if only from their sporting features. These rods can be obtained made entirely of steel, and the superior grades of these are delightful to use and besides they are quite unaffected by climate.'

10. *Spoon bait and scale effect on spoons.* It is difficult to explain what a fish imagines a spoon to be. I am reluctant to say he thinks it a fish; and it is a perfectly logical assumption to think that he, like most creatures, has a certain curiosity for new things, catches it with his mouth, as we would with our hands, and so comes to be hooked.

Mahseer prey more on sick and damaged fish, or small fish at a disadvantage. A spoon may present a likeness to a wounded or sick fish, but I am afraid I can see no resemblance to a healthy fish more especially in still or slow running water.

In a rapid it is quite another matter, for a feeding fish is an opportunist, and has no time to inspect a spoon dancing about in broken water. He darts out and takes it. This is substantiated by watching a fish in a pool while trolling. He will come up and even follow a spoon; change over to a dead bait and he takes it, which might be the work of the barbels on the mouth, referred to by fishermen as 'coming short'.

In the case of scale-marked spoons, I found I never had a blank day, when every other kind failed; and with them I was, in 23 days, able to catch 800 pounds of fish, the best being 75 pounds and then after having worked through many kinds and varieties. Try a spoon similar to the Myitkyina type as shown in the chapter on 'Tackle', get it to spin any speed in water below you, and see for yourself whether or not the scale effect shows up.

11. *Hen fish attain greater size.* Fish, like falcons and eagles, appear to reverse the general laws of nature, in that the hen fish (spawner) attains a greater size than the cock fish (milter). It may be a provision of nature, to assure that the spawn of a hen fish can always be reached by the cock fish when she migrates up into small

streams. If the tables were reversed it might be possible that the cock fish through his size, could not always get where the hen fish selected to deposit her eggs. Only a surmise on my part, and an assurance to my own curiosity!

12. *Fishing for mahseer: Spinning.* I will start by assuming that the angler has now learnt the use of the tackle, can cast a bait, has seen to all the important factors of the reel working well, the joints of the rod firm, the trace correctly attached, the spoon bait and lead mounted, and the end of his line tested.

13. *Where to look for mahseer: Rapids.* The rapid will provide the best sport for spinning, as feeding fish invariably collect in the 'bottle necks' where small fish are to be had at some disadvantage. Small fish will collect in the quieter water of rapids, that is in

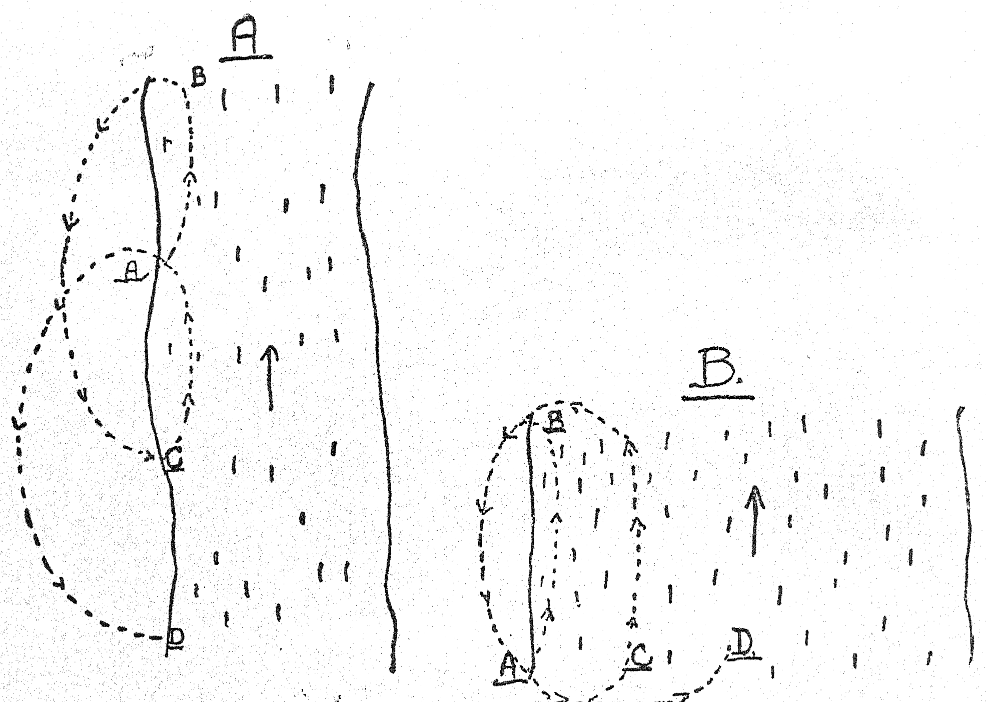
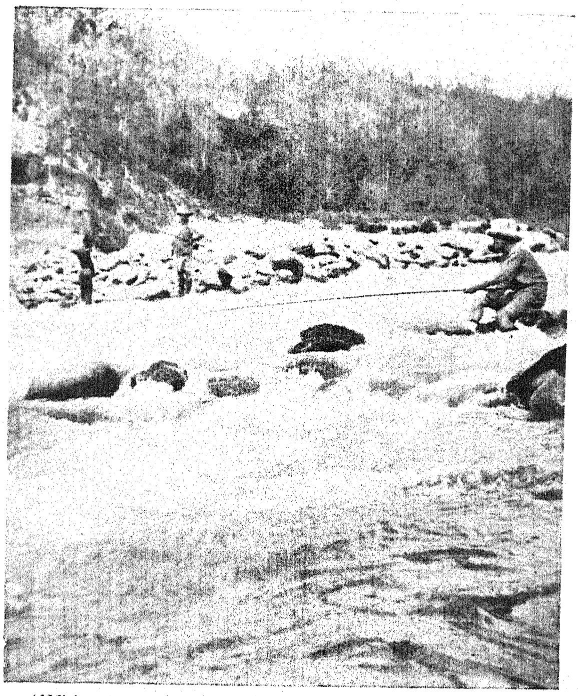
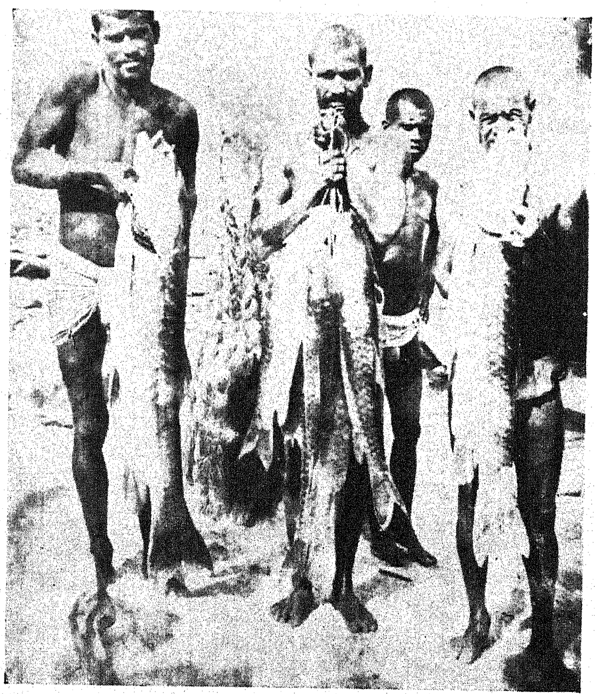


Fig. 22.—Start at 'A' and work down to 'B'; then come around to 'C' and work down to 'A' and up to 'D', and so on in each case.

'feathers' behind rocks; in the eddies and swirls by the edge of the fast water; or below falls where the force of the water is broken, affording them temporary rest from the fast rushing water of the main current. So that generally speaking this is the water we should consider and work thoroughly.



'White water' where large fish are usually taken.



Part of a bag taken in the rapid shown above. Two best 30 and 25 lbs.

Just above runs are spots where the water flows deep and strong, and where it gathers itself for the final plunge down the rapid. This is smooth and oily looking and should always be tried.

Before starting to fish take stock of the water, and look for movements of fish, gulls, kingfishers, etc. Make a mental note of the likely places and number them off in your mind. Tackle each in turn. If the rapid is long and narrow quarter it off in your mind and fish each section thoroughly, starting from the top of the section each time. See diagram (A) overleaf Fig. 22.

If on the other hand it is a wide and shallow rapid, and allows wading, quarter it off and wade in so many yards at a time, and work each section thoroughly. See diagram (B) overleaf Fig. 22.

It is a sweat sometimes, but I assure you it pays. Work the edges first, then move in at suitable distances, and work down as far as you can. When you are taken or you move a fish fix the point in your mind at once by setting two points on the bank, a tree, boulder or brush wood, for future use and reference.

Work all the water in a rapid from the head, where it breaks over stones and is shallow, to the point where it 'fans' out in the pool. Fish will take anywhere in such water, give the 'white feather' behind rocks and boulders special attention, and the 'V' formed by the fast and reverse water; work these as quietly and with as little disturbance as possible. If the rapid is large, and a boat is necessary, follow the same procedure. Have the boat held at intervals to allow you to fish all the likely water, then move up or down ten yards or so and repeat the operation.

A very good tip and one that frequently pays with dead bait, is to allow your bait down the rapid by degrees, past boulders, swirls and eddies, very often this attracts fish lying at the side or behind a submerged boulder. In fact, wherever the water is fast and narrow, flowing over large boulders, it is a good plan to fish it in this way first, or wherever the water does not allow of casting and spinning, owing to the narrowness of the run, or the 'boil' being under a large overhanging rock, or the many other similar conditions met with. Allow the bait to play about in such water for a minute or two, then move it down to the next place and so on. Very often it also pays to pause awhile after wading out into a rapid as, however careful, one is sure to disturb the water and be detected by fish. Allow the water to settle down and get used to you, so to speak, so that the fish too will be assured that you are just part of the rapid. It is most extraordinary how this pays, and how fish will almost bump up against you, if you keep perfectly still.

14. In order to simplify these notes, I have included a sketch of a mile of ideal water and lettered the best places, to look for fish.

The map is taken from my log book, and illustrates water likely to be met with in most hill rivers (*vide* Fig. 23).

(A) Is a large pool, 500 yards long, by 60 yards across with 30 ft. of water in the deepest parts. It is the first pool below where the river leaves the hills, always a good place if sufficient protection is afforded by boulders. Trolling across from where the Jogi Khola joins (below and above would be likely water), also up the right bank, where the still water has banked up below the junction at (B).

(B) The junction is not very imposing, the Jogi Khola has about $2\frac{1}{2}$ ft. of water, where it runs over shingle into the main river, and falls over a steep bank abruptly into deep water. Below such banks, and in the quiet water between the two channels, usually holds fish, but it must be approached very carefully, and is best fished from the island.

(C) Is the 'fan' which is almost without exception good if boulders are present, as in (J). This is water *B. bola* (Indian trout) love, and I never failed to take two or three each time I fished it.

(D) Is the best rapid in this stretch of water, from the junction of the two channels to the 'fan' into the pool, about 40 yards short of the junction (B). It is fast water over large boulders 5 ft. in diameter, with the main current about 40 yds. across and 10 ft. deep, shelving to the sides for about 20 yards where the water is 3 to 5 ft. deep, permitting wading. This is excellent water for big fish.

(E) The point at the junctions of two streams, generally has a 'ridge of boiling water running out for some distance, caused by the banking up of the lesser streams by the stronger. This is generally a certain find for feeding fish. If the water is deep at the point, it should be fished from above, and the spoon or bait allowed to work down. Work all the water from the actual point to where this boil disappears. Fish will take anywhere in such places.

(F. H.) Are modifications of (E), and should be fished in the same way. It is light water 4 or 5 ft. deep with boulders dotted about, and about 25 yds. wide. Best worked from (I) through (I), (H), (G) and (F), first from one bank then, after a rest, from the other, keeping the sun in front of you and wading in where necessary. It is ideal fly spoon water. The 'fans' at (G) and (I) should be approached from above in each case.

(G. I.) Are 'fans' falling away into small rapids on either side of the island, and are best worked from the banks and above.

(J) Is an ideal 'fan', defined by dotted line, and a certain find for fish, having plenty of 'feathers' behind large boulders. It is 50 yds. across, 3 to 5 ft. deep, and connects the two large pools Gooncha and Nunthur.

(K) Is 'white water', broken up by three huge boulders, forming 'feathers', and falling 5 ft. in as many yards. This is big water.

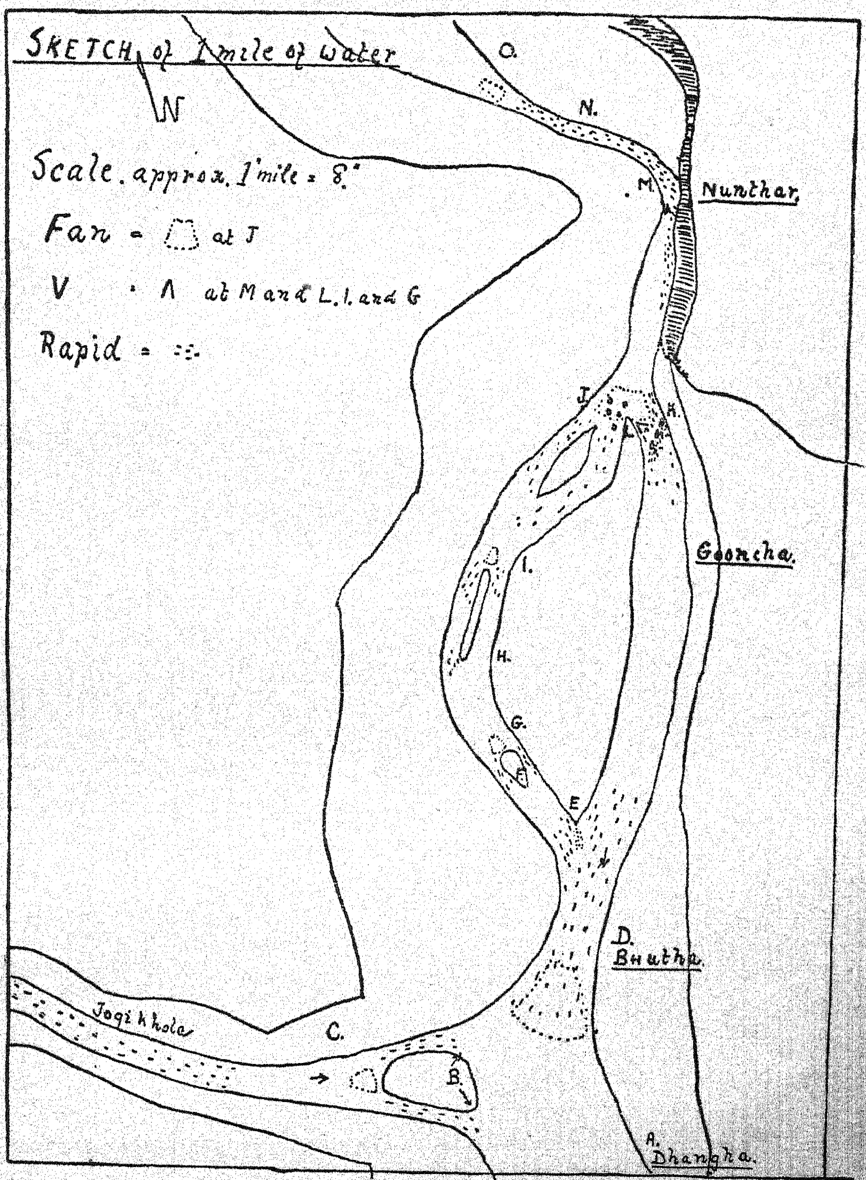
(L) This is a 'V' formed by the reverse water and rapid, (marked in with a 'V').

(M) Tail of rapid starting at (O), into deep pool below cliff. This is also a 'V', with slow water tailing into the pool.

(N) Deep very fast water, narrow and deep over large rocks or slabs of sand stone.

(O) Similar to (J), but without 'feathers' or boulders, running in a deep narrow channel over shingle.

Gooncha and Nunthar are both huge deep pools, ideal for fish, The former is rocky at the head and sandy at the tail, the latter runs along a cliff, very deep with huge slabs of sand stone dotted about at intervals.



Sketch map of water likely to be met with in most hill rivers.

15. *Pools.* The water in a pool may be still and glass like, or slow moving with odd swirls caused by out crops of rocks, shallow banks, bays, etc., so that I can only refer my remarks in a general way to the most suitable water.

The really big fellows will usually be taken in the pools by fishing deep and slow, with a dead bait or spoon. I myself like to work a trolling bait diagonally across a pool, so that the bait is carried well below the boat, and at least 20 yards or so away. Work all likely water near rocks, swirls, over boulders, and along the edges of the flowing water formed with the still back-water where you will generally find froth and foam collected. Best of all is the tail of the pool where it shallows down, and just before it starts to flow down the next rapid.

16. *How to work water.* Fig. 24 shows how to work a promising bit of water. Vary the length of cast each time, if possible, then move up or down stream, and repeat the same system of casts.

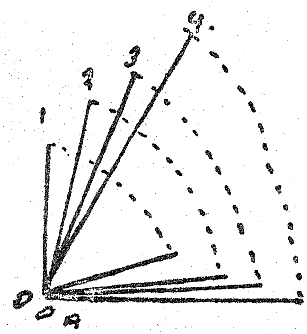


Fig. 24.

The Cast. (A) is the position of the angler—(1) is the first cast, (2) the next and so on until (4). These are made out and into the rapid at right angles to the bank. Allow the bait to swing round and below you before winding in. Feel the spoon all the time it is making this arc of a circle through the water, as this is when one is usually taken. Try to reel in your bait up the side through swirls, by rocks and where the reverse and rapid water meet. This and behind rocks, is where big fish mostly lie when feeding.

17. *Known water.* If you are fishing water that is protected by a club, and a log book is kept, the first thing to do and before you assemble your rod, is to study the notes and any sketches there may be of the water you are going to fish. Jot down as many of these as necessary in your pocket book, locate the spots and always tackle the best water first. If it is a rapid, you should start at the bottom, if you want the big ones.

The larger the fish the lower down he lies in the rapid, or he may be at the head of the pool, usually where the rapid tails into it. If you are on a new piece of water, of which you have no previous information, try to get out the evening before to see where fish rise.

Fish lie with their heads up stream, and bait-spoon or natural, cast up stream, is often more successful than casts made across or down. Method has to be suited to water conditions, and for these directly up-stream casts, reeling in has, to be more rapid, and a mutiplying reel is an advantage, almost a necessity.

There are always back-waters on the edge of rapids, where the water works round in a circular movement, in the opposite way to the current. Sit and watch from some convenient spot or spots, with the assistance of an attendant if necessary, each taking a

section of water, to observe which looks the most promising. As the sun is beginning to set, you will usually see mahseer rising over the best places.

18. *How Mahseer rise.* They rise much the same as the dolphins and porpoises in the sea or large rivers, and are easily distinguishable. Their hog backs come right out of the water; but it is not always that you will enjoy such delectable sights. In many fine rivers the fish are not seen, or their presence known, until the reel screams out its music.

Try all the good looking water on one side, before attempting to fish the other. It is always owing to that spirit of adventure which is in us, that the further bank is the better one. The rapids, if shallow, are best in the morning and evening, and the deeper quieter water during the day.

Fish deep and as near the bottom as you dare, and don't be satisfied until you have felt it once or twice. If however, you are losing your tackle each time, take off the hook mount, and survey the bottom with only the lead and spoon. Get the hang of your water in this way and then fish deep where you dare, and shallow only where you must.

Some of the water is so deep in Burma rivers, that I know of a most experienced angler, who has caught some large mahseer of 70 and 80 pounds, who used to count ten after a cast with a 4-oz. lead on, paying out line the whole time before he started to wind in his bait.

I am convinced that this is the secret of catching the really big fellows. Let us consider our grandparents and their lack-a-daisical mood. They are not moved by the latest hit in the town, to which the young 'bloods' flock. They are quite satisfied to sit in an easy chair and take the news and diet that is served on them, with as little trouble as possible to themselves. This is how I reason also for the grandmother mahseer. If you put your spoon near her into the depths, she will take it, otherwise she will let it go to the younger and more active fish.

19. *Monotony of one bait.* Here again if you strike or lose a fish at one spot, do not go on hurling your spoon at him the whole day. You know what poached eggs daily for chota hazri taste like? You are not altogether kindly disposed to the servant! A fish with a torn or hurt jaw is going through much the same feelings, if you continue to serve up the spoon from which he has just escaped! Rest the water and come back to it in a couple of hours. Remember your fish—the real big one—is generally a hen, and extend the psychological factor to our own kind. Women are ever inquisitive and easily caught, change the fashion in spoons, and hope the fish, like women, will bite!!!

It has been my experience when fishing, that as long as one lands the fish one strikes one can keep on fishing the same spot with success, but as soon as you run and lose a fish, they seem to go off the feed. Whether they have a means of communicating danger to each other or not, it is difficult to say.

Let me here draw an analogy of the human ear and the lateral line of a fish. It is possible, that as certain sounds have adverse

effects, such as the soothing sound of music or the irritating yapping of a dog, or child crying; so, vibrations set up by the different lures, may have similar reactions on a fish. Which are soothing, and which are annoying or alarming, is what the angler must find out for himself.

Remember these three big points when playing a fish.

1. Point of rod up.
2. Line always taut, and
3. Play a fish off the reel and through the rod.

20. *Point of rod.* The moment you are taken, and your reel screams, the first action should be to raise the point of your rod, as high as you can, or give him 'butt' as it is called. This puts both pressure on your fish as well as saves your line slacking, for even that fatal second. It also serves as an indication of when to reel in, for you will soon learn how the rod is forced down, and your arms pulled almost straight, by the first mad rush of a big mahseer. It is at the end of the rush that the critical time comes; for if the line is the least bit slack when the fish turns, the chances are that you lose him. This is the commonest and easiest fault while playing a fish.

By playing the fish off the reel and through the rod, I mean to imply that you should not use only the one or the other. If you overbrake your reel, you are putting all the strain on the rod, and likewise, if you point the tip of the rod in the direction of the fish, you are direct on the reel, and you lose the whole advantage of the rod; compromise between the two and you get the correct pressure; if your reel is large enough, and takes 300 yards of line, you can rest assured that you have enough line for the largest mahseer. Don't brake a reel or foul the handle of the drum while it is revolving. You will come to grief if you do; just study what you are doing. With a brake on you are unable to gauge what pressure you are applying, however expert you may be, and by putting your hand in the way of the handles, you are sending out a succession of jerks which go down the line to your hook-hold, and furnishing the best way of releasing your fish. We all know what it is like to pull a firm peg from the ground by gentle pressure, but a few taps and it comes away. Exactly the same applies to the hook hold, and what your hand is causing to the fish's mouth by fouling the handles.

21. *Selection of water.* I am a firm believer, when on a short holiday, in sticking to a piece of water you know is good, rather than spending a week of leave by exploring new places; but if one has plenty of time on hand look for new water every time.

22. Lacey's *Angler's Hand Book,* gives the figures of his luck, through a career of fishing for mahseer, and these are interesting, as he must have kept careful notes. He works it out over 10 days, in the following way (Inserted from Lacey's *Angler's Hand Book*).

'I do not wish to discourage the beginner, but to take an average all round, say that out of ten days steady fishing, taking rivers and seasons about, the angler will, as a rule, have 5 days blank, 4 days on which he will have perhaps, moderately good sport, but the tenth will be the really good day, which should make up for all the rest.'

The above is an average, and such has been my own experience while fishing exclusively for heavy fish. I think that 7 days out of ten, good fishing can be had with fly spoon, and something on the other three.

I like to reason this subject in the same way as heavy mahseer fishing compares with big game shooting, and light fishing with the 'scatter gun'. In the first place blank days are to be expected; we do not get every tiger that kills, or every bison or tsine we track, but seldom do we go out with 'scatter gun' or fly rod and not get something.

I give as a matter of interest, the log for my last seven trips which are representative of the average river. (See p. 54).

As will be seen no exceptional days were experienced, as is sometimes the case when the small fish are running or the large fish are collecting. My companions on these trips were, with the exception of two, all new to the sport, so that we may justly conclude either that sport is better than it was when Lacey wrote his book *The Angler's Hand Book* or modern methods are proving more successful.

23. *Wade cautiously.* Movement above where fish are feeding, causes some disturbance and displacement both of water and gravel while wading. This is connected with some unusual occurrence to fish, and they become alert. The hungry fish will look for food, the shy fish for danger. Adapt your methods to meet both cases.

24. *The element of luck.* It remains a mystery why on one day fish will feed ravenously, and the next day, (though even to the keenest observer both days appear identical) not a fish will move. Time in trying to study the causes is never wasted, and notes made, such as temperature of water and other cognate matters, always assist one. I have had equally good luck on cloudy and sunny days, windy or still days, and even thunderstorms have not disturbed the fish. They have their feast and fast days, as we have ours, but the reasons for this are what every angler should try to elucidate.

25. *Water and temperature.* Unlike the English fish, the mahseer will take in gin clear water, in fact the clearer the better. Do not despair if water is running dirty; quite often fish will take a spoon in water so discoloured that you cannot see the bottom in a depth of 12 inches. If you know the water it helps, as fish will generally be found in the same places as when the river was clear. I have taken fish with spoon in water a companion of mine refused to fish in. After all, if the lateral line has the function we attribute to it, why should a spoon spinning in a good spot, not attract a fish? Dead bait used the same way is also effective, and here suit your methods to the chemical senses. The functions of the eye in clear water, are replaced by those of smell and taste in discoloured water.

The temperature of water has its effect on fish. When the water is cold the river will seem quite lifeless. Falling water has its supporters, but I think we are, comparatively ignorant of the 'whys and wherefores' of our scaly friend's capricious appetites. Study good days as well as bad, both are equally important. Do not fall into a groove of supposition that it is useless to fish at any time,

SUMMARY

Date	Locality	Fish	Weight	Average	Rods	The Day's Best Bag	The Day's Best Fish	Best Bag in Pounds	No. of Fishing Days	Blank Days	Percentage of Successful Days	Remarks
11th April to 8th May 1928	Mali H'Kas Burma	53	861½ lbs.	16·25 lbs.	1	50, 42, 1, 34, 18½	75 lbs.	145½ lbs.	28	12	57%	Practically all the time was devoted to heavy fishing.
4th April to 8th June 1935	Sarju and East Ramganga Kumaon U.P.	207	870¼ lbs.	4·3 lbs.	1	36, 30 7 lbs.	40 lbs. 96 lbs. Goonch	73	50	16	68%	Fly spoon and heavy rod used equally.
10th to 27th October 1937	Nepal	28	274½ lbs.	9·8 lbs.	1	21, 18, 16½, 10, 5, $6,4^2$, 2^2	29½ lbs.	92½ lbs.	18	3	83%	
11th to 26th April 1938	Do.	102	558½ lbs.	5·4 lbs.	2	29, 23, 16, 9 and ten others		123½ lbs	16	Nil	100%	Mostly fly spoon, with occasional days with Spinning Rod.
12th to 31st March 1939	Do.	46	207¾ lbs.	4·5 lbs.	1	13, 5½, 4½, $1\frac{1}{2}^3$	27½ lbs.	27½ lbs.	20	2	90%	
21st to 31st October 1940	Lahya Kumaon	155	142 lbs.	·9 lb.	3	21 fish	9½ lbs.	34	10	Nil	100%	All light work with fly spoon.
23rd March to 6th April 1941	Nepal	161	605½ lbs.	3·7 lbs.	4	12 fish	37½ lbs.	90½ lbs.	15	Nil	100%	Mixed work. Fly spoon and spinning.

except the mornings and evenings. More especially where streams meet, or when a river has been discoloured by rain water, the fish start to feed irrespective of the time of day, and the moment it starts to clear. They may be hungry from not having fed for three or four days, and are on the look out for food as soon as the water is clear enough to allow of it.

There is no better way of meeting the local people than to talk to them in their own homes about sport and their crops. Play the gramophone to them, dress their sores, give the children a few sweets and keep both ears open for local ideas. The primitive people, such as one usually meets on a fishing trip, are largely dependent on their wits for fish and flesh, and have experience handed down to them for generations. Exploit and adapt their suggestions and ideas, and with your own knowledge you can very soon arrive at a killing method. This recalls to me an incident at Namti in Upper Burma, where I tried to catch some mahseer in a pool just below a village by spinning; the fish would not look at my bait. An old Burman saw my failure, and as I had been there before asked me if he should collect the fish, to which I gladly assented. He then started breaking up pumpkin leaves and throwing them into the slow water, which in a short time was alive with mahseer. I attached a hook and light gut cast, and with this leaf caught seven nice fish. The village feasted in my honour and we became very good friends for ever after.

26. *Following in a boat.* Boats, if available, are the best things in which to follow fish. One can concentrate on the fish the whole time, and not have to worry about where to put one's feet, or how to climb over rocks while following down a bank. The Burmans, or better still the H'Kamti Shans, in fact all the fisherman tribes in India, are wonderful at manipulating a boat through the most treacherous water. They seldom if ever lose their heads, and have a wonderful sense of correction while the boat goes hurling down a rapid.

If, as usually happens some time or other while on a fishing trip, the water is discoloured, baiting can be done quite successfully by getting rice or flour mixed with earth or any other ingredients, such as bran, oilcake, and the more foul tasting things, bad meat etc. and fixing it into two wicker baskets, tied over one another. This is placed in a run, where the water churns up and washes it out through the sides of the basket by degrees, when it works down stream and fish move up towards it. A live or dead bait should be anchored just below the basket. This gives very good sport, if one is driven to it with no other alternative.

Dead bait fishing is done in the same manner as spinning, and does not call for any special explanation.

OTHER METHODS OF FISHING FOR MAHSEER.

27. I have dealt chiefly with spinning for mahseer, which is quite the most pleasant of all, and the way most of the large fish are taken. I have also dealt with trolling, and dead and live bait fishing.

It will suffice to say a few words on how to fish with fly, gram, and paste, which cover all the ways we know of circumventing this fish. All these methods, with the exception of paste, might be considered under light fishing.

28. *The fly and fishing with fly.* A number and variety of flies are listed in the tackle books, and one must suit ones fancy to the local conditions and tastes of the fish prevailing, which is only picked up locally from experience. Manton's list 12 of the best known, and be it a 'Jock Scott', 'Blackamore', or 'Black Ranger', must be your individual choice.

Sea-trout flies, dressed with sufficiency of tinsel, the two hooks of stouter wire than the flies made for home use, are said to be effective lures for mahseer, Indian trout, Butchwa and other fly takers. They should be dressed to imitate the smaller minnows prevalent in the water being fished.

It sometimes happens that flying white ants flutter in myriads over the water affording a great feast for fish. At such a time they will look at nothing else. The fly known as 'Gibby's Ant' (A & N Stores Bombay) will then prove successful.

In rivers the fly should be used in the same way as for salmon, pulling the fly with uneven speed and occasionally pausing, giving it a chance to spread and assume a life-like movement of opening and closing. Allow the water to play it about keeping the line taut enough to enable you to strike instantly. It is also a good dodge to drop your fly in fast water passing over a steep step, and where it suddenly falls away deep, pay out line by raising the top of your rod, and then lowering it, you must always feel the line or you will miss a rise. Such places usually hold feeding fish. Striking is the same for all fish, and is made by sharply lifting the point of your rod, with the line free. A strike off the reel is good enough for the leathery mouth of the mahseer. In comparison, I think the artificial fly is an inferior bait to fly spoon; and fewer fish, both in size and numbers are taken than with a very light spoon which is made from tin foil or aluminium. It starts spinning the moment it touches the water. Fly has a traditional love attached to it, and keeps your hand in for the home fish when the spot of leave comes along. So, brother angler, weigh its merits for yourself.

29. *Gram fishing for mahseer.* This form of fishing is almost exclusively practised in most of the C. P. rivers, where the mahseer prefers it to any other form of bait.

Fish of ten pounds and under are taken in this way on light tackle, and afford excellent sport on a fine cast, and a small hook with a 9 or 10 ft. trout rod. The tackle for small mahseer is suitable.

30. *Method of fishing.* First select your water. The best places are runs into pools, waterfalls, and bathing ghats, or rocky gorges. This done the selected spot must be baited morning and evening with parched or roasted gram, and when it is thrown in to the water, especially in the case of slow or still water that is very clear, the man who is doing this for you, should be instructed to keep out of view (in the case of runs and waterfalls it is not so

important). If a suitable rock or bush be near-by, all the better, the arm too should not be flourished about in the air when fishing, but the gram flicked from the hip, with as little movement as possible. This is the most important thing about this form of fishing. If you are resident in a place and baiting can be done daily, the fish are in time educated and get accustomed to the sight of man, and will associate him with food, and little precaution will be necessary. I refer more to the visitor to the wild parts of rivers where he may happen to be shooting, and is intending to have an occasional afternoon's fishing under these conditions. Fish may collect in one, two, or four days, depending on the size of the river. When they have collected in sufficient numbers, fishing should commence. The mornings and evenings are the best, the earlier and later the better.

31. *Gram for bait.* Selected grains should be drilled with a piece of wire beaten into a spear point, and large enough to take the eye of your hook. (Special gram hooks are sold by Messrs Verona and Mantons of Calcutta). An orderly or *chaprassi* can be put on to this job the day before; carry a small tin of drilled gram in your pocket for bait.

32. *Hooks.* As already mentioned special gram hooks are offered by tackle dealers. I like Hardy's sharp loop-eyed hooks the best. They are very light and sharp and can be attached or removed from the cast in a moment, and the spring extension keeps the gram in position. Size 11 for one grain, or size 9 for two grains; the eye can be passed through the drilled gram quite easily, and the cast attached by the loop. I am against any form of metal, other than the hook, on the cast or at the joining of the cast to line. This makes your line and cast sink faster than your bait, and scares the fish.

Fig. 25.—

33. *Cast lines.* Do not spare gut, and use a 6-ft. cast of 2x. gut.

34. *Tackle.* A small Silex $3\frac{3}{4}$ inch or any other suitable reel serves the purpose. A 9-ft. or 10-ft. fly rod that will throw a small spoon makes the ideal rod for this form of sport. (Hardy's 'Perfection' or 'Gold Medal'.)

35. *Other tips.* When your fish is hooked, if he makes either up or down stream, follow and shelve him, as far away from your baiting place as possible, so as not to disturb the water; for if you do not move away, he will surely return to the other hungry fish, and splashing and turning, as a hooked fish does, will spoil your sport for a time.

Before leaving the place throw in more gram, so that the fish can again feed after the scare has worked off, and the bolder fish will attract the shy ones.

Lightness of tackle and limited movements, with as little disturbance as possible to the natural elements of the water, are the three things to sum up the precautions to be taken in this form of fishing.

36. *Paste fishing for mahseer.* This covers a much wider range than the two preceding methods, and may be productive anywhere from north India to the south of Burma. It is a bait all varieties

and sizes of fish will accept. Conditions must therefore be adapted to the rivers in which one is fishing.

In coloured water, in the largest rivers, or in the C.P. rivers in the same place as gram fishing is practised, and under similar circumstances, paste will bring the mahseer and other sporting fishes of India to bag, provided the local conditions are taken into account. It is however a dull form of sport compared to the foregoing methods. I have mentioned paste in Chapter X.

37. *Baiting with paste*. This can be done along with gram, in the same places, so that when fish have stopped feeding on the surface, one may try the paste balls on the bottom, a method which generally produces carp, mahseer, or, as I have said before, perhaps any other fish or even a turtle!!

The method of baiting with *Atta* is to make small paste balls the size of Dove's eggs, and throw them in, in much the same way as gram. When you are going to fish with atta, the usual few pellets should be thrown in, to collect the fish. When you send down the baited hook amongst them, be it rapids or slow water, keep out of sight as far as possible, or if this is not possible, then as still as possible. As with all wild life it is movement, not form, that alarms.

Baiting a hook for this fishing, can be done in no better way than with paste dealt within the manner I have mentioned in the Chapter 'Scraps from my Note Book'. By boiling it it holds on to the hook, and is not washed off by the rapid water, or the small fish nibbling. I prefer a single hook to a treble, though the treble holds the paste far better. A fair-sized hook, to take a lump of atta the size of a dove's egg. Any shape of hook does, and is a matter of choice or fancy. 'Killen wire' for the heavy fish and gut for the medium-sized ones, meets the purpose. The awful snags that these C.P. rivers have, with the knife edge trap rock bottom or sides, gives a fish a distinct advantage over the angler for freedom. For attaching hooks and tying casts, see Chapter V.

For paste fishing for the very large mahseer taken in the rivers of Mysore the bait is made from 'ragi', a staple grain of Mysore and other parts of South India. This paste is strongly adhesive to the hook, and both the balls thrown in as ground bait, and those used on the hook, are the size of large hens' eggs. December-January and September-October are the best months. Single hooks, size 4/0 are used, and the turned-down eye is best. Gut or wire trace is not advisable: line should be of dark colour. No float is used: strike should be hard, to drive in the hook, as soon as the fish begins to move.

38. *Heavy Mahseer fishing*. I will conclude this chapter with a few points which require mention, and which are more especially concerned with heavy mahseer fishing.

1. This is hard work and it is only perseverance that brings reward.

2. If you want to catch the monsters you must know where to look for them, and above all, you must get your bait down to the fish.

3. Get into your mind the ideal water for fly spoon work, then

try to find these conditions in a big way, that is, instead of the rapid being 4 feet deep and 40 yards across, find one 20 feet deep and 150 to 200 yards across. Here, or in deep pools, with slow runs into them, or in bays by the side of rapids.

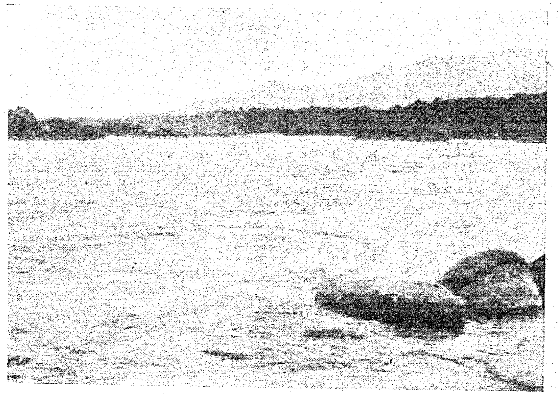
4. Big water wants a great deal more fishing than does the ordinary rapid. The first cast may only tickle the fish, the second draw or attract him, the third or fourth will bring him to the bait.

If your boatmen can ferry you across the smooth water above one of these rapids, and your nerves will stand it, your reward awaits you. I was taken above the 'Rocks' rapid in the Myitkyina District of Burma, three times in three tries, by monsters. I saw them in the clear shallow water (8 ft. deep), but what with having to make the bank 100 yards away, and the roaring torrent below, either my nerves gave and deprived me of concentration on the fish, or the 300 yards of line proved inadequate.

I gave these monsters best here, and never tried again as it was only asking for trouble. What tempted me to try at all was the monsters I saw rising the evening before. I camped on the bank opposite, and after showing the boatmen fins and tails, the like of which they had never seen, persuaded them against their wishes to try it. (An angler's nightmare).

In conclusion I would refer anglers to Col. R. W. Burton's article in Vol. 41 No. 4 of the *Bombay Natural History Society's Journal,* 'A Mahsir River in Southern India'. It is a complete guide to the Bhavani river, by an able and experienced angler. Also two articles by Major W. B. Trevenen 'Mahseer fishing in the Deccan Lakes' and 'Fishing in the rivers of the C.P.' (Vol. 31, No. 1, p. 120 and Vol. 34, No. 3, p. 700). A well illustrated article by Sir Reginald Spence and Mr. S. H. Prater entitled 'Game Fishes of Bombay, the Deccan and the neighbouring districts of the Bombay Presidency' appeared in Vol. 36. No. 1. of the *Journal* (pp. 29 to 66). It was written as a help to anglers in the Bombay Presidency, but contains information of interest to anglers in most parts of India. It is obtainable in pamphlet form on application to the Society.

1. A panoramic view of the famous confluence looking down from the bungalow.



2. Famous rocks 22 miles north of Myitkyina.

3. Mali Rapid into confluence F—G is excellent water.

Chapter VII.

The Mahseer in Burma.

Oh! Scaly monsters of the deep, or of the turbid stream,
Reveal your secrets now and then, and fulfil the Angler's dream!
Why do you accept my bait one day, disdain it on another?
Though light and shade prevail the same, please what's the secret khubbar?

I cast my spoon and hide from sight, the same from day to day.
Sometimes you take it at my feet, anon just swim away!

Large sums I spend on rod and reel, all to beguile and fight,
Hundreds of miles I go in search, to test your strength and might.

Into the bowels of the Himalayas, to Burma, Assam, Mysore,
And barren mountains and waters small, Quetta, Banu, Tor.

Then to Trap Rock and Tiger Land, where only gram you take,
Raipur, Saugor, Seoni, in Tapti Sone or Berach.

Pride of place in my heart I give, to your Ava cousins all,
Be they monsters of the Mali H'ka, or Barilius Bola small.

Long may your secrets remain your own, and long may your haunts prevail,
For this after all is the fun of the chase, to find you, lure you, then fail!

A. M.

The Chindwin (1), The Irrawaddy (2), The Salween (3), Tenasserim (4), Size of Mahseer (5), Burma Record and Record Mahseer (6), Varieties of Mahseer (7), Golden Mahseer (8), Thick-lipped Mahseer (9), Black Mahseer (10), Copper Mahseer (11), Chocolate Mahseer (12), Red Mahseer (13), Points to remember when fishing (14), Best season for catching fish (15), Fish destroyers (16).

Fishing Small Streams in Burma. Isolation not a factor (17), Tackle (18), Summary of a Fishing trip in 1928 (19), Notes from Myitkyina and Seniku Fishing Notebook (19), Bait (20), Fishing conditions (21), Tackle (22), Quotations from Notes (23), Big Fish (24), A comparison of the Mali and N'Mai Khas (25), List of fishes to be caught (26), Extracts from the Myitkyina Fishing diary (27), Extracts from the Seniku Fishing Diary (28), More extracts from the Myitkyina Fishing Diary (29), Notes on the Mali K'ha (30), Notes on the N'Mai K'ha (31), Notes by Capt. Finch (32), Myitkyina Fishing Association (33), Mr. T. P. Dewar's notes (34).

The Mahseer in Burma.

In devoting a special chapter to Burma I do so with recollections of perhaps some of the finest fishing waters in the Indian Empire, for they hold a variety of mahseer the study of which affords a most interesting subject. As a province it is, with Assam, the best and most adapted to the mahseer. This is on account of

its net-work of rivers, forest clad, and for the most part unmolested by the ravages of man or beast. Sir George Scott writing in his book *Burma and Beyond* says:—

'From the stretch of hill country between Assam and China a number of mighty rivers start to run southwards in nearly parallel courses. They supply all the water that is wanted for cultivation and irrigation in Indo-China. They begin near one another in a very narrow span of longitude, and gradually spread out in a fan, which covers the lands from the Yellow Sea to the Bay of Bengal. All of them run in deep narrow rifts, and the ranges which separate them go on running southwards almost as far as the rivers themselves, and in China almost as sharply defined as the river Channels.'

'These mountain ranges fall away from each other as the river valleys widen, and they lose their height as tributary streams steadily cut through the ridges which form herring-bone spurs and spines. But they still keep the same north and south direction, though here and there spines re-enter and form the series of flat-bottomed valleys and wide straths which make up the Shan States.'

'Of all these rivers the Salween most steadily preserves its original character, for it flows swiftly down in deep channels, sometimes precipitous gorges between high cliffs, from its source till it reaches the plain-land, which it has itself piled up over the sea in the course of ages. It runs down the centre of the British Shan States, and these lie towards the fringe, and nearly in the centre of the fan, which has for its ribs the Brahmaputra, the Irrawaddy, the Salween itself, the Mekhong and the Yangtzu.' The chief rivers in the north are the Chindwin on the west, the Irrawaddy in the centre and the Salween to the East, with the Tenasserim in the South.

1. *The Chindwin.*—Fed from the west by the Manipur river and its smaller tributaries and from the east by the Uyu and its many affluents, all of which hold mahseer; for some unaccountable reason the fish of this river are reluctant to take spoon or spinning bait. This has been the experience in the past, and it must for this reason alone be classed as an indifferent fishing river below Homalian. In the Hukawng valley, where the Chindwin rises, the fish run large and are game, taking spoon readily; the upper reaches of the Uyu, coming from Mogaung and Karmaing in the Myitkyina district, also afford excellent sport.

The circumventing of the fish in the Chindwin is an unfinished study in the case of the western rivers, though not to such an extent with the eastern tributaries.

2. *The Irrawaddy.*—Roughly dividing Burma lengthways has some 700 miles of course before it empties itself into the sea below Rangoon. It becomes the Irrawaddy 29 miles above Myitkyina, the most Northern district of Burma, where two rivers of equal size, the Mali and N'Mai H'ka come into confluence, forming a picturesque junction and an angler's paradise. The fishing water may be roughly defined as being above Katha. It is not really good till Bhamo, but is par-excellence above Myitkyina whence, from the confluence of the Mali and N'Mai H'ka to Fort Hertz up the Mali, and H'Tawgaw up the N'Mai, there is approximately 120 miles of water on each of these rivers. Fish run to any size, and many a monster is to be seen cruising in the backwaters of the Mali from the road above at Teing H'ka. At the actual confluence I have taken a 75 pounder and fought for two hours with another monster and then lost him. In the Myitkyina District there are numerous large spring-fed rivers that make excellent junctions with these two rivers, the Mali and N'Mai, and some wonderful bags have been made in the past.

3. *The Salween.*—This great river, which is navigable for hundreds of miles inland, is hardly touched on in any books as a fishing river. I here again quote Sir J. G. Scott from his book:

'The Salween is one of the most astonishing rivers in the world. Its sources are not accurately known, and throughout its whole course, in British territory at least, it preserves the character of a gigantic railway cutting or canyon. Though it runs from North to South, it has a variety of bends that prevent any very long view up or down its course. The banks rise to thousands of feet on each side, and often so sheer from the water's edge that there is seldom room for any sort of camping ground on either side. In the dry weather there are what may be called 'bays' of blinding white sand, or a chaos of huge boulders strewn broadcast; and here and there, where a tributary enters, a stretch of pebbly gravel. The rocks are of the hardest kind, siliceous and even vitreous, and yet they are ground and scored by the stones borne down by the current. The rocks for the most part are coated with a glistening polish, as if they were black-leaded, and when it is considered that the sun can only shine down into this great gorge when right overhead, and that blankets of mist lie over it every morning, its austerity may be imagined'.

'A feature of the Salween is the extreme coldness of its waters, partly caused by the melted snows coming down from the sources, but partly also because of the lack of sunlight. In the cold weather the mist hangs over it densely like a blanket, but in the hot weather it rises half-way up the hills, and remaining there produces the phenomenon of sunshine above and a clear atmosphere over the river bed. This blanket of fog is found by aneroid to measure a thousand feet with a clear atmosphere above and below'. The average difference between high and low water in the Salween level is sixty or seventy feet, and in some places as much as ninety feet. There are many rapids in the current, and many reefs of rock running across. In the time of high water all beaches and boulders are lost, and the water actually laps the steep slopes of the forest. The current varies extremely; there are sluggish reaches, and then races. Native boats at certain seasons of the year can ply on it, but continuous navigation for any length would be impossible.'

'There are many ferries for traders at various points, but in some the ferry-men live in villages high up on the hills above, and the steepness and the absence of proper landing-places make the working of these ferries both difficult and erratic.'

'The drenching mists would lead to fevers and ague, it might be supposed, but the Red Kerens, and others who live in the District, seem to be immune from long acclimatisation.'

'At five miles below the Keren-ni border the busy part of the river begins, with the Ta Taw Maw ferry, and from here the river is a regular trade route down to Moulmein and the coast.'

There is little to be desired more than this as a fitting description of ideal mahseer water. Whether it is because the higher reaches of this river traverse wild country out of the beaten track of the 'White man', or because of lack of enterprize by residents of the neighbouring stations, I have found it difficult to get in touch with any one who has fished it, or knows anything about the fishing this river offers; but that there are huge mahseer in it, is certain. A correspondent writes me that a nephew in the Bombay Burma Teak Corporation told him of having seen shoals of masheer 6 ft. in length cruising at certain places in the lower Salween, on the Siam Border.

The rivers coming in on the left bank from China should certainly hold mahseer, even though the rivers coming in on the right bank from the Shan States are almost denuded of fish life by the extensive irrigation. This appears to have been the experience of most anglers posted in the Shan States: and we read in 'The Mighty Mahseer' that it is hardly worth wetting line in any of these rivers. An illustration of what poaching and extensive irrigation will do.

4. *Tenasserim.*—In the south this river has afforded excellent sport and the rubber planters have made some big bags. Trips are made by motor launch into the higher reaches where large fish of 50 or 60 pounds have been taken so that, generally speaking, we might justly conclude that the Mahseer is common throughout Burma; and one can reasonably expect to find him in any perennial stream which is rocky and rises in hills, irrespective of where it joins the larger rivers. As an illustration of this see Sahmaw Chaung further on in this chapter.

5. *Size of Mahseer.*—To what size we may expect fish in a river depends largely on the size of its waters. The larger the river the bigger do fish run.

The limit of the size a Mahseer attains is put at nine feet.

6. *Burma record and Record Masheer.*—The best taken to date in Burma is 92 lbs., caught two miles below Myitkyina and a souvenir of the fish was in the Myitkyina Club. The record Masheer caught on rod and line is 119 lbs. This was taken in Mysore; it was 64 inches long and had a girth of 42 inches.*

That this grand fish can be beaten in Burma I am convinced. I have myself seen fish nearly 6 feet long at Tiang-Kha, 40 miles north from Myitkyina, that must have been 150 lbs. At the confluence of the Mali and N'Mai Rivers also, I have seen fish rise that were 18 inches across the back, if an inch. This much suffices then, to show that we have in Burma Mahseer as large as anywhere else in the Indian Empire.

7. *Varieties of Mahseer.*—Burma in particular is fortunate in offering opportunities for studying the much neglected subject of the varieties of mahseer. Thomas in his 'Rod in India' of 1873 invited the attention of anglers to this study. To give up catching fish when they are on the feed, and write down copious notes and details of an unusual fish is not a very interesting occupation, still it is time well spent, and invaluable to Natural History. By doing this in 1928, I was able to open up the question of whether there are not at least 6 distinct varieties of mahseer to be caught. The photographs contained in this chapter show the difference but they are not conclusive enough. If anglers would only further note down the colourings and different characteristics of such fish, we may prove this by specimens packed and forwarded to the Bombay Natural History Society. (See specimen form elsewhere.)

The six types of Mahseer that I caught are as follows; and though they differ all fit Doctor Day's *Barbus tor* in the main points.

8. *The Golden or Himalayan Mahseer* is the commonest and the same as the Indian fish, which are represented by two forms:—

(*a*) Golden Mahseer. The Putitor Mahseer, *Barbus tor putitora* (Hamilton) known in Assam as the 'Greyhound' fish. It is usually long and narrow, with a distinct black line down his entire length, two and a half scales in width above the lateral line, head large and long, top half green, lower half pale green running into silver.

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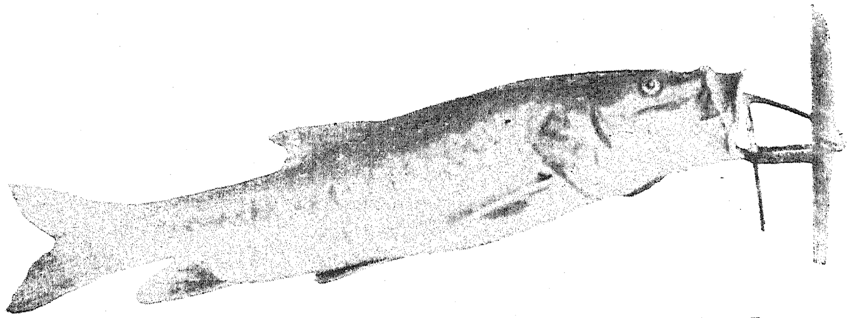
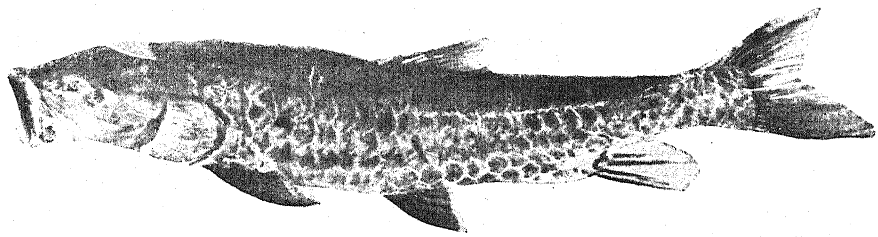
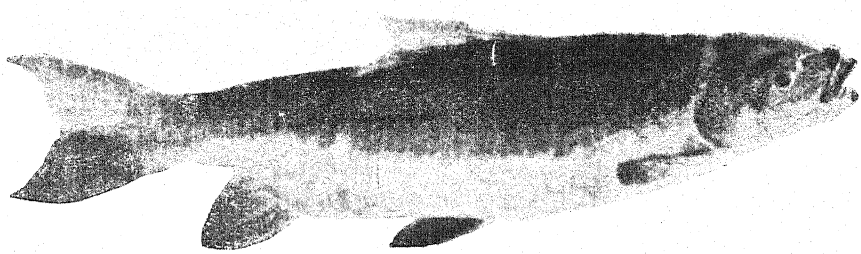
[1] Since beaten by Mr. Van Ingen, 120 lbs. Mahseer caught by him in April '47. Also in Mysore.



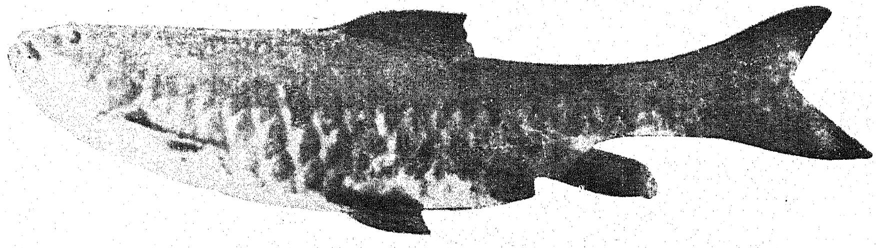
1. Golden or Himalayan Mahseer, *Barbus tor putitora* Hamilton, 23 lbs. Because of its long body, referred to in Assam as the Greyhound type.



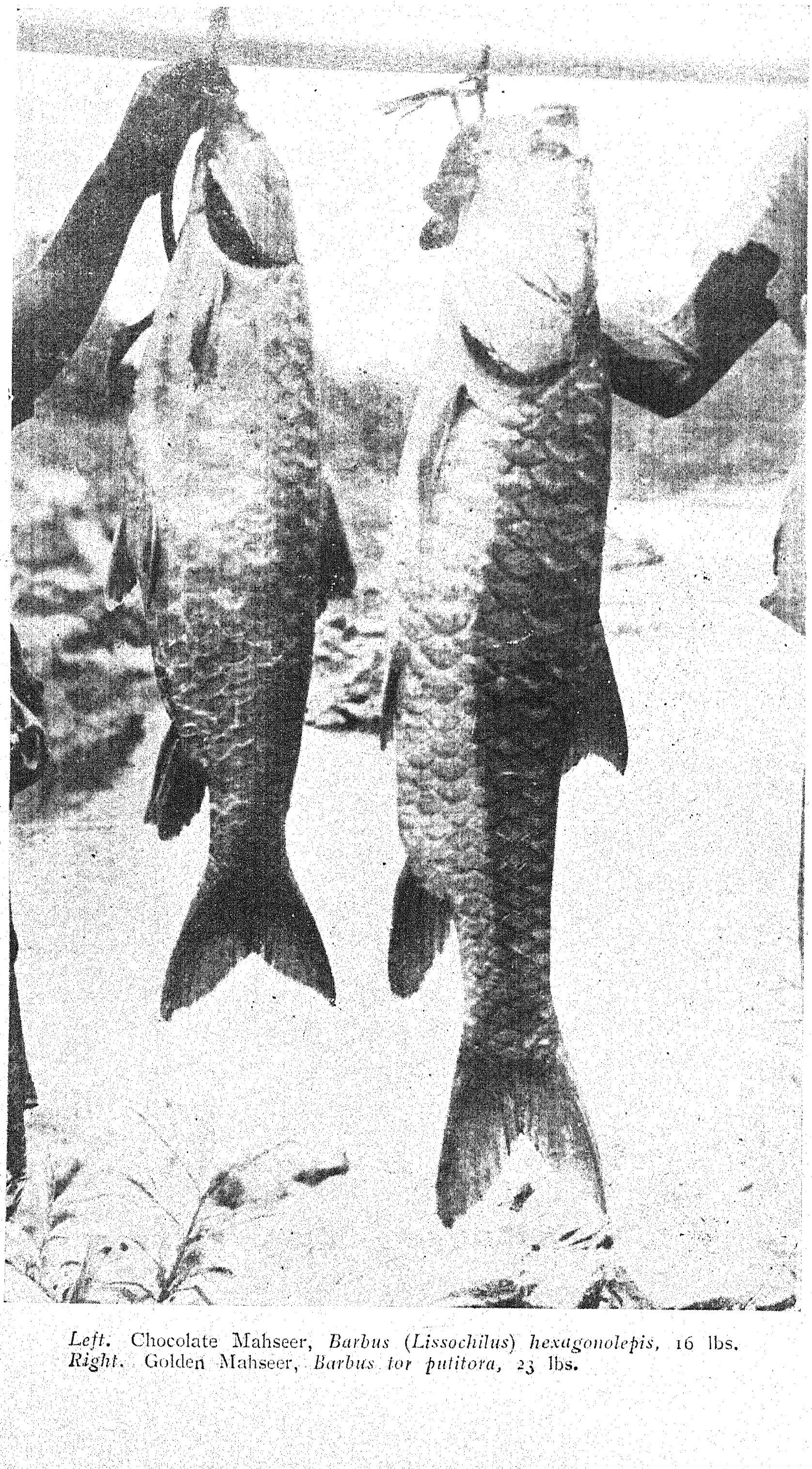
2. Black Mahseer. A colour variety of the Putitor or Golden Mahseer.



3. Chocolate Mahseer, *Barbus* (*Lissochilus*) *hexagonolepis*.



4. Red Mahseer. Another colour variety of *Barbus* (*L.*) *hexagonolepis*.



Left. Chocolate Mahseer, *Barbus (Lissochilus) hexagonolepis,* 16 lbs.
Right. Golden Mahseer, *Barbus tor putitora,* 23 lbs.

Above lateral line from golden with a mauve tinge on silver grey background. Fins blend with colouring; dorsal green and dirty pink, ventral and pectoral pale green to olive with red fringe. Eye: iris golden, pupil black. Belly white.

(*b*) The Tor mahseer, *Barbus* (*Tor*) *tor* (Hamilton). This is rather uncommon, and is generally taken with paste or dead bait, fishing on the bottom. The head and mouth is smaller, and body deeper than in the first type, the colouring is much the same as the first type. See photos opposite. The scientific names have been adopted from Dr. Hora's article *Game Fishes of India,* from the *Bombay Natural History Society's Journal,* Vol. xli, No. 3, page 521 dated April 1940.

9. *Thick-lipped Mahseer.*—The thick-lipped mahseer has the same colouring as the Himalayan mahseer differing only in the head. Chief features are the thick lips with the adipose extension. Hora classifies this fish as a variation of the true *putitor* mahseer, the development of the lips not being as yet cleared up.

10. *The Black Mahseer.*—Two distinct types are taken. (*a*) Is stocky in build, head small and black, mouth small, barbels and eyes black. This fish is marked by a jet black line two half scales above the lateral line; scales above lateral line have a tinge of gold on the scale tips running to jet black on the back. Below lateral line scales are lighter but dirty white, almost shot black to the scales on the belly which are dirty white with a black fringe. Fins black with grey at base. It is fairly common in the streams which are heavily wooded, and is almost without exception a very game fish.

(*b*) Is a melanic form of the *putitor* mahseer.

11. *Copper Mahseer.*—The copper mahseer is quite the most beautiful fish I have seen. He is bright copper all over with a sheen running into all the colours of the rainbow, he runs from the deepest shade of copper with the delicate mauve sheen throughout, to the more delicate shades of copper with shell pink, on a background of shot silver and gold. The head is small and nose slightly concave, the lips are a modification of the thick-lipped variety. The adipose continuation of the lower jaw is clearly defined, but very much modified and not so pronounced as in the thick-lipped variety. Fins deep blue, except tail fin which has a red fringe. Belly delicate shade of yellow eyes bright copper; pupil deep indigo blue. Only three of this variety were caught in 1928 at the confluence of the Mali and N'Mai Rivers; best fish weighing 25 lbs. no black line down the side.

12. *The Chocolate Mahseer.*—Head round and square and small like a *Labeo,* colour bronze, running through delicate shades into purple. No black line above lateral line. Above the lateral line chocolate running into blue to dark chocolate on the back, with polished bronze tinge to scale tips. Below lateral line, running from faint silvery blue to white on belly to the extent of three complete rows of scales, with half row on either side, clearly defined, making four. Bright orange spots under lower jaw on chin; lips thin, mouth small. Fins sky blue; iris chocolate; pupil black. Two fish of this kind taken, best 28 lbs. taken also at the confluence of the Mali and N'Mai Rivers.

13. *The Red Mahseer* has a round and small head, top of which is shot gold and purple, also gill plates; mouth small. Above lateral line, beautiful sea green shot with silver, tips of scales salmon pink. Below lateral line, mauve with silver, vermilion tips to scales; belly pink, fins all bright red; black line above the lateral line not present in this fish. Eye golden, pupil indigo blue. Took five of these fish at the same confluence, best 18 lbs.

A study of the photographs will convince anyone interested, that these fish bear marked differences to each other both in colouring and shape. This is of no value to piscatology, but if fishermen are able to differentiate the varieties, my object will be fulfilled; and if further pursued, by specimens being sent to Bombay, we will have at least opened up this neglected but interesting study.

From the recent work by Dr. Sunder Lal Hora, on the Game Fishes of India, appearing in serial form in the *Bombay Natural History Society Journal*, and from correspondence I have had with him, he has identified these fish as follows:—

The Chocolate Mahseer ...	*B.* (*Lissochilus*) *hexagonolepis* (McClellan) only colour forms.
Stocky Black (*a*) ,, ...	
Red ,, ...	
The Golden Mahseer ...	*B. tor putitora* (Hamilton).
The Thick-lipped Mahseer.	The hypertophied lips being only a peculiarity, not yet fully investigated.
The Black (melanic) (*b*) Mahseer ...	
The Copper Mahseer ...	*B. tor mosal* (Hamilton).

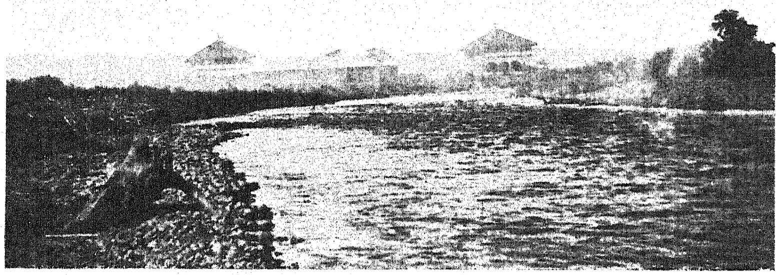
14. *Points to remember when fishing.*—Mahseer which have not been 'educated' by wielders of the spinning rod are not, so far as my experience goes, shy or difficult to catch; so we need only follow the usual rules of fishing, to be successful. There are, however, one or two points of importance which, if mentioned elsewhere, will also bear repetition here, as being of special value while fishing in Burma, where the dense forest that grows to the water's edge of most of the rivers supplies various leaves, fruits and vegetation to form a diet to which these fish seem particularly partial. The large jungle figs, so abundant at certain seasons, are much sought after; also the larger forms of insect life.

In the matter of spoon, fishing deep meets with success; in fact it is only by so doing that one hooks the really big fish. The use of as fine tackle as is compatible with the size of the fish, combined with the least conspicuous mounting and hook arrangements, amply repays the careful fisherman in these gin clear waters.

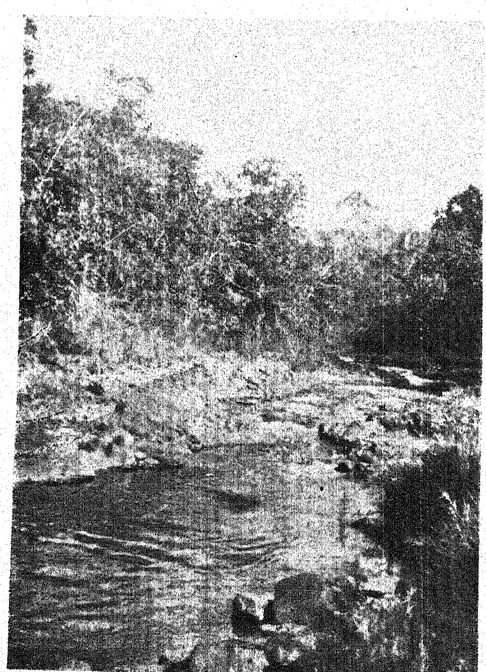
15. *Best season for catching fish.*—The general idea of the autumn and spring being the best seasons does not appear to fit most of the rivers of Burma. This is also the case in Assam. Langley's famous catch of 876¾ lbs. of mahseer in two days was made in November up the Mali H'ka, and good bags have been made by others at the same season. It is interesting to note that these cold weather catches have all been made at the junction of spring-fed rivers, with the N'Mai H'ka and the Mali H'ka, both of which are snow fed, and probably connected with the winter spawn.

Left. Thick-lipped Mahseer, *Barbus tor putitora* (Hamilton).
Right. Copper Mahseer, *Barbus tor mosal* Hamilton.
Note the pronounced adipose extension of the lips in the larger fish. It is a peculiarity not yet fully investigated.

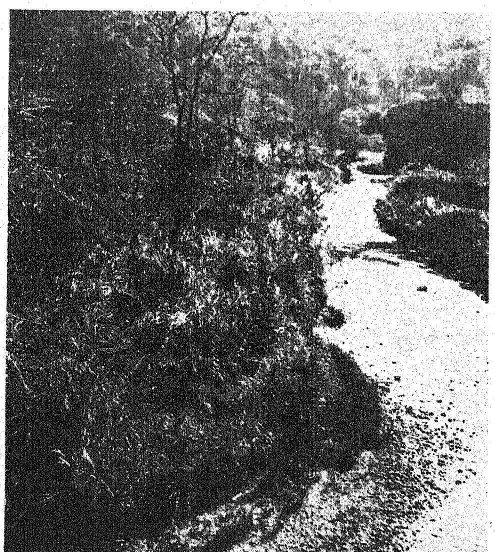
THE SAHMAW CHAUNG



1. View through Finlay Fleming's Estate.



2. Hill section, holding fish from 8-10 lbs.



3. Another view of Hill section. Typical *B. bola* water.

16. *Fish destroyers, Crocodiles and Turtles.*—The upper reaches of the Irrawaddy from Bhamo are free from crocodile and turtles, and the fish are assured this much immunity in having nothing larger than the otter to destroy them. This is a curious situation, and rather unaccountable as the Mogaung and Namyin, and the Uyu are all large, sluggish rivers, with rocks and sandy beds, especially adapted to these fish-eaters; game also abounds for the mugger in the dense forest that grows down to the banks. Long may this remain foreign to these pests.

The upper waters of the Chindwin also, I understand, are free from the crocodile, and the turtle is rare, though one was caught on a Victor rod by Mr. T. P. Dewer in the Hukawng valley, 87 lbs., while fishing with a spoon ! !

Otter. Otters abound and there is hardly a stream free from them. I have seen schools of as many as eleven, hunting together in small streams. They occasionally damage large fish, and are besides Man, practically the only destructive creature in these waters.

Man. Even in Man we may count our luck as being well in, for the best fishing water in Burma is undoubtedly in the Hill tracts. These are administered by the Burma Frontier Service, whose officers are both policeman and magistrate. No settlement is allowed in these tracts by our Aryan brethren, so the country remains unspoiled and wild. Long may the policy last.

I refer to Kachins chiefly, who fortunately for the fish are a lazy easy-going people, and slow at exterminating fish. They have their primitive methods of trapping, shooting with arrows, cutting with *dhas* by night with the aid of flares, even poisoning the fish, but with all this, are not nearly as destructive as the fishing classes in India, who deplete a river in a short time. In some streams fish are partly protected, by the local *Dewar,* or chief of a group of villagers, who allows trapping to be done only after permission is obtained, or when he has a feast. So long as these Hill tracts are not thrown open to colonization, we may hopefully expect to see mahseer remain in the same great numbers as at present.

Fishing small Streams in Burma.

There is abundant opportunity for the Angler who wishes to try Fly, or Fly Spoon, in the innumerable small streams that drain this forest clad land.

In fact, almost any stream, however small, will hold Mahseer and Trout (*B. bola*), provided it rises in the hills, and is perennial. It seems immaterial where these streams meet the larger parent rivers, or whether the bed is shingle or sand, fast or sluggish.

Let me here describe just one such stream. I will take as an example the Sahmaw Chaung, in the Myitkyina District.

I was resident on Finlay Fleming's Sugar Estate for 4 years. It was then in its embryo stage; I was employed in the process of opening up vast areas of grass land for sugarcane cultivation, so I was able to study the river fairly thoroughly. I had some

200 mahseer, ranging from 4 lbs. to a ¼ lb., protected behind my bungalow, under a large concrete bridge. These were fed daily, and fishing was forbidden for a distance of 300 yards above and below.

This little burn is no more than 15 miles over its total length, and about 10 yards across at its widest part, and is nowhere over its whole length more than 8 feet deep. The drop is considerable, and it is consequently a series of shallow runs and pools, varying in depth from 3 to 6 feet.

The bed is shingle with small boulders 18″ in diameter and the water gin clear. The banks, for the last four miles of its course, and where it flows out into the valley are covered with high grass (*Saccharum plumeosum*) known locally as *Kaing* grass, but better still as tiger or elephant grass, growing about 12 ft. high.

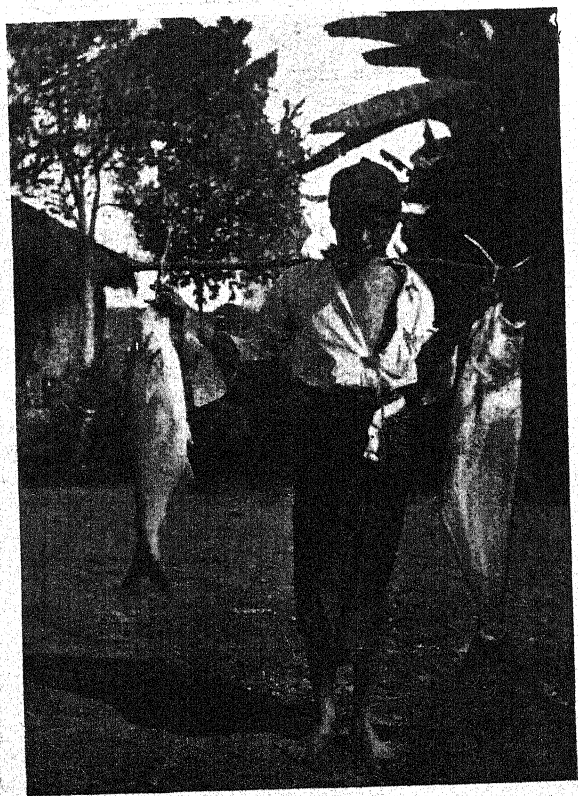


Fig. 26. Two good Silund (*Silundia gangetica*) taken at the mouth of the Namti H'kar 22 and 15 lbs.

I have taken Mahseer up to 7 lbs., out of this little stream, and *B. bola* of 3 lbs. It is full of fish, and a dozen or so small mahseer may be taken any day, over a couple of miles of water.

B. bola of good size and in plenty, may be had over the whole stretch of river.

I give below two specimen days, with these fish :—

Date	*Fish*	*Bait and Tackle*	*Remarks*
12-4-1925	3 . 2 . 2 . $1\frac{3}{4}$. $1\frac{1}{2}$. $1\frac{1}{2}$. $1\frac{1}{4}$ $1\frac{1}{4}$ and 6 others = 17 lbs. Mahseer	$\frac{1}{4}''$ copper and silver Spoon	Salt lick. Fished all day. Put 6 back.
5-7-1925	3. 2. 2. $1\frac{1}{2}$. $1\frac{1}{2}$. 1. 1. 1. and 24 others = 19 lbs. *B. bola*	,,	Below North alignment from 9 a.m. to 11; put 18 back.

17. *Isolation not a factor.*—The interesting feature about this little stream lies not so much in the fish it holds, as in its isolation and distance to the nearest Mahseer water. The Sahmaw stream flows into the Namyin Chaung. A slow sluggish river with a sandy muddy bed, draining the Mu Valley for 40 miles or so; and emptying itself into the Mogaung River 20 miles from where it takes in the Sahmaw Chaung. Over the whole length of its course it is free from rapids, and has no mahseer. The Mogaung River is a very considerable stream, but is also muddy and sluggish, and has no rapids or runs for 30 or 40 miles from where the Namyin joins; so that this colony of mahseer, in the Sahmaw Chaung, is isolated and is at least 50 miles from the nearest suitable water, with no other smaller tributaries in between.

I deal with this at length, in order to illustrate the possibilities of fishing in the many similar streams found in Burma. There is of course no doubt about any small streams that run into the rivers in the Hill tracts, as these are bound to hold fish.

It is interesting to note that in the hills, where the Sahmaw Chaung runs through a small defile, two or three large pools have formed in which can be seen from above fish of 15 lbs. or more. It would be most interesting to know the age of these fish, as their size is out of all proportion to the size of the stream. They are resident there at all times of the year.

18. *The tackle* is the same as for all light fishing, but the lighter the gut and smaller the spoon, the better. I found 3x gut and a $\frac{1}{4}''$ Fly Spoon answered best. Fly took well, but did not give the good results of the Fly Spoon, with either *B. bola* or Mahseer.

A chapter on Burma cannot be considered complete, without some reference to the famous 'Confluence' and to the water above Myitkyina.

I have included in this chapter notes from my own diary, with a summary of my bag, not with any object of exemplifying my results, but to illustrate to the would-be visitor what he may expect. For although this is wonderful water, it is by no means easy, nor does the reel sing at every cast. These are results of 10 hours of hard fishing daily.

For the condensed notes of the fishing round Myitkyina, I am indebted to Capt. Finch, who put in a great deal of hard work compiling them, when Hon. Secretary of the Club.* They give any

* This is probably the only remaining record after the invasion by Japan and destruction of records before evacuation.

one interested, all the details required, and should the reader wish to satisfy himself further, of these two famous places 'The Confluence' and 'Seniku', I can only suggest his getting Sheets 92 to G/6, and 92 G/14, scale 1 inch to a mile, obtainable from the Government Map Depot, Calcutta, and studying these with the notes.

It is to the co-operation of anglers in making notes in the fishing books at these places, that we owe all this interesting data.

A great pity it is not done more by station clubs, all over India

TRIP TO CONFLUENCE OF THE MALI AND N'MAI K'HAS, 1928

Date	*Summary of Bag* *Locality*	*Weight*
11th April, 1928	Confluence	
12th ,, ,,	Rocks	
13th ,, ,,	,,	
14th ,, ,,	Confluence	6, 7, 3.
15th ,, ,,	,,	
16th ,, ,,	,,	25, 30.
17th ,, ,,	Waishi	
18th ,, ,,		
19th ,, ,,	N'Sop Zup.	10.
20th ,, ,,	,,	$4\frac{1}{2}$.
21st ,, ,,	,,	26.
22nd ,, ,,	,,	
23rd ,, ,,	Tiang Zup.	
24th ,, ,,	,,	12.
25th ,, ,,	N'Sop Zup.	
26th ,, ,,	,,	
27th ,, ,,	Confluence	75, 10, 48^{a}, 3.
28th ,, ,,	,,	28, 6, 3, 3, 2^{b}, $1\frac{1}{2}^{c}$, 1^{b}, 1^{b}, $\frac{1}{2}^{b}$.
29th ,, ,,	,,	12, 13, $17\frac{1}{2}$, 18.
30th ,, ,,	,,	44, 25, 5^{b}, 4^{b}, 2^{c}, $3\frac{1}{2}^{c}$.
1st May ,,	,,	23, 10.
2nd ,, ,,	,,	28.
3rd ,, ,,	,,	50, $18\frac{1}{2}$, 42^{a}, 34, 1^{c}.
4th ,, ,,	,,	23, 16, 12, $1\frac{1}{2}$.
5th ,, ,,	,,	
6th ,, ,,	,,	27, 24, 14.
7th ,, ,,	,,	21.
8th ,, ,,	Rocks	21, 15, 9, 6, 6.

These include Mahseer and other varieties, [7]Butchwa, [2]Goonch and [4]*B. bola*[2].

53 fish weighing 861 lbs. giving an average of 16·25 lbs.
The best day 3rd May. 5 fish weighing $145\frac{1}{2}$ lbs.
The 4 best fish 75, 50, 48, 44 lbs.
[2] Goonch = *a*.
[7] Butchwa = *b*.
[4] *B. bola* = *c*.

SEASONS.

Up to date 1932.

19. *Condensed notes from the Myitkyina and Seniku Fishing Note Book.*

(By kind permission of the Hon. Secretary Capt. Finch and members of the Fishing Club.)

Mahseer have been caught in every month of the year, but undoubtedly both in the Mali and the N'Mai, the most promising seasons are from late February until the end of April or the middle of May, (depending upon the

incidence of heavy rain) and also parts of September, October and November. The majority of big fish have been accounted for from the upper Mali in the Autumn, and from the N'Mai in March and April during recent years. The earliest in the year that a catch is recorded is 13th January. One enthusiast landed fish in July and August, and accounted for a couple on 30th December, but this may be regarded as somewhat exceptional.

During the Rains, tributary streams give some sport with small fish, both fly-spoons and flies being successful.

In the Autumn, much depends upon the state of the water, a paucity of rain being conducive to sport with really large Mahseer.

20. *'Baits', etc.*—The most satisfactory 'weapon' for these waters is the Spoon. Opinions differ, of course, as to the size and type of spoon which is most killing. A copper and silver spoon of almost any shape, mounted with a flying treble hook is recommended. Two experts, whose names figure as the captors of numerous monster Mahseer, employed home-made spoons not exceeding about two inches in length. Many useful fish have been landed on spoons of four inches and over.

(The writer landed a 65 lbs. on a $1\frac{3}{4}$-inch spoon, and a $1\frac{3}{4}$ lb. on a 3-inch spoon from the same rapid, and the only things that he has hooked on 4-inch spoons during hours of spinning are:—(1) a submerged cabbage, and (2) portions of Asia. Chacun a son goût.)

If fish are feeding or inquisitive they will take anything, even discarded cheroot ends. Prior to 1914, success was frequently achieved with dead bait; live bait has also been used, and these should be resorted to when the water is very dirty and spoons have failed to attract.

Flies and fly-spoons have sometimes given amusing sport in tributaries. In certain places, wild figs, pieces of leaf and those cheerful little insects called by the Burman 'payit', fished near the surface, have caught small Mahseer. 'Phantom' minnows have not proved a success in these waters. The record Mahseer for Burma was taken bottom-fishing with Atta from the Irrawaddy not far from Waingmaw a few miles below Myitkyina.

The 'chocolate' mahseer is partial to a worm!

21. *Conditions for Fishing.*—Mahseer have been caught on bright days, on dull days, during rain, even during thunder storms, before noon, at noon, after noon, and after sunset. At any phase of the moon.

Mahseer can be caught on ordinary tackle in dead clear water, in pale green water, in beer-brown water, in pea-soup.

When the river is high, when it is low, when it is rising, when it is falling. The ideal? *Quien sabe?*

In the Spring, I think, when the water is clearish, not transparent, but translucent to a depth of about three to five feet; then good catches may be hoped for.

In the Autumn, when the sun has had a whack at the water, and the water is rather dirty and falling fairly fast, fish may be hooked, particularly where a tributary adds clearer water to the main streams.

When the temperature of the water is high, fish will be more numerous in broken water and close to falls.

When the water is very cold and clear, a few mahseer can be hooked usually in broken white water.

Fish may really be 'on the feed' for most of the day, or perhaps for only half an hour. No definite rule can be laid down as to the best times for fishing. As an example of the impossibility of knowing whether morning or evening fishing will prove the more successful, the following catch, (from the N'Mai), is quoted:

September	*Morning*	*Evening*
18th. 5 fish	Best 30 lbs.	Not a touch.
19th	Nil.	5 fish, best 20 lbs.
20th. 5 fish	Best 49 lbs.	Nil.
21st	Nil.	Nil.

22. *Tackle.*—In the Myitkyina District, the all-round angler should supply himself with an outfit to meet the following varieties of fishing:—

(*a*) Spinning deep in fast water for fish up to 100 lbs.
(*b*) Trolling from a boat or raft.
(*c*) Casting a fly spoon and fly fishing.

(These notes are given as a rough guide, in case they may prove of assistance to anyone who has not as yet fished in the East.)

(*a*) 'Heavy' Spinning:—

Rod:—Should be of Greenheart, split cane sometimes fails in a tropical climate. Length 11 to 12 feet is enough.

Reel:—Must hold over 200 yards of suitable line.

Line:—'Lignum Vitae', 36 lbs. strain, from Manton's Calcutta is good.

Traces:—Strong killin Wire.

Leads:—'Jardine' spinning lead type, up to 1¼ oz.

Spoons:—Get these made from samples by a lohar, or Indian artificer, and mount them yourself with a flying treble-hook. Good types:—(all obtainable from Manton & Co.).

Name	*Colours*	*Sizes obtainable*
The 'Putao' Spoon.	Dull copper and silver.	1½, 2, 2½, 3 ins.
Special Hog-backed.	Gilt both sides best.	Sizes Nos. 4 to 10.
The 'Myitkyina' spoon.	Brass and silver.	Scaled, 4 inches.
Hardy's Hog-backed.	Mahseer.	
Spoon.[1]	Bright gilt and silver.	1", 1½, 2, 2½, 3 ins.

Dead bait tackle.—The Archer Spinner, to take a fish 3 to 6 inches long. Lacy's chilwa tackle.

(*b*) Trolling from a boat for big fellows:—

A Sea Rod about 8 feet in length.
A large reel to carry 300 yards of line, with an extra brake.

(*c*) Fly Fishing:—

Dark coloured flies seem to be the most killing, also white or yellow flies at times. Mahseer will probably take any fly occasionally, Suggested:—Watson's Fancy, Blackamoor, Black Gnat; also

[1] A good shape; Hardy's wire mount is unreliable, sometimes fraying through from twisting when a fish is 'on'.

Coachman, Smoky Dun and Yellow Spider, sizes 2, 6, 10; and 12 for barils.

Gut casts as for equivalent weights of salmon and trout.

Accessories :—

One or two intelligent piadas or orderlies: a gaff or landing net is seldom needed.

A Spring balance, to weigh by ½ lb. up to 60 lbs.

A pair of wire-cutting pliers; a small file.

A baiting needle. A tackle box.

Plenty of spares to replace those lost.

23. *Quotations from Notes on Tackle.*—'This fish' (a 32 lbs.) 'fought too much for my split cane rod and it has a bad kink just below the base ring.'

'Have found no line to equal "Lignum Vitae" from Manton' (Sk. P. 211).

'For traces nothing but "Killin" wire . . . For spoons I prefer the old-fashioned bar-spoon.' (SK.P. A.D.).

'Do not have a "triangle" in the belly of the spoon, which may be crushed flat by a fish, resulting in oaths and loss. A fish making an attempt at the spoon will slip on to a single tail triangle and be hooked.

Large mahseer have been caught on the following varieties of spoons :—

1½,	2½,	3,	3½,	4,	4½,	4½	inches	copper and silver ;
1½,	2½,	3,		4,		4½	,,	all copper ;
1½,	2½,	3,	3½,	4,			,,	brass (or gilt) and silver ;
1¾,		3,		4,		4½	,,	silver.

Spoons of many different shapes, 'mistri'-mado, made by Farlow, Luscombe, Manton, Hardy, etc.

There is so far no record of any mahseer having been hooked on a 'Phantom' 'Devon' or similar toy, in local streams.

Further Notes on *Tackle*; contributed by two successful anglers.

Spoons.—(*a*) 'A two-inch copper and silver spoon, with a treble hook flying mount. I have also found useful a silver and brass about three inches and rather narrow—this in very strong water.'

(*b*) 'I prefer the "Myitkyina" shaped spoon, sold by Manton. . . . . . Dull outside, bright inside.'

Lead.—(*a*) 'I have always used a 2½ oz. lead—triangular shape.'

(*b*) 'I use as much as the rod will stand in most places, and let the lot sink as far as I dare. You lose a lot but it pays: about 4 oz., I think.'

Dead bait.—(*a*) 'Dead bait I have tried on a few occasions with success usually at a junction where one stream was dirty and the other clear. Bait just on the margin of the dirty.'

Line.—(*b*) 'I use waterproofed plaited cutty hunk or similar. Silk is too expensive and rots, breaking strain about 20 lbs. I rub it with Cereline (Hardy's) every day or so and dry carefully every evening. Backing, undressed cutty hunk, very strong.'

24. *Big Fish.*—Undoubtedly the keen angler who is determined to go 'one better' than his predecessors stands the greater chance of landing a record if he concentrates upon the warm waters of the Mali H'ka, or the Mali at the 'Confluence', which have surrendered more fine fish in a shorter period than those of the chilly N'Mai.

Nevertheless, the fortunate fisherman who has worked hard and been blessed with good weather conditions, may hope for a catch from the N'Mai which will rival those given up by the Mali.

For comparison, a list of large mahseer caught from both rivers is given on the next page.

25. *List compiled from notes in the Myitkyina and Seniku Fishing Diaries up to 30th June 1931.*

Mali H'ka and Confluence — Fish weight over	80 lbs.	70 lbs.	60	50	40	Total	N'Mai H'ka: 80	70	60	50	40	Total	
Prior to 1915	1	...	...	1	...	2	2	...	2	4	3	11	Prior to 1915
1915 Spring	...	...	...	...	1	7	...	...	1	...	...	1	1915
Autumn	...	2	...	2	2								
1916 S.	...	...	2	1	...	(a)	...	...	...	...	...	...	1916
A.	...	...	...	9	6	18							
1917 S.	...	2	...	4	...	(b)							
A.	3	1	2	...	...	12	...	...	...	1	1	2	1917
1918 S.	...	...	...	1	...								
A.	...	...	...	...	1	2	...	...	...	1	1	2	1918
1919 Spring	...	...	1	1	2	4	Best Recorded 32 lbs.						1919
1920	No Record						...	...	1	...	...	1	1920
1921 Autumn	Bad Year				1	1	Best Recorded 37 lbs.						1921
1922 S.	...	...	1	1	...	3	...	...	...	.	...	...	1922
A.	...	...	...	1	...		...	...	...	.	...	...	
1923 Spring	...	...	...	3	2	5	No Record						
1924 ,,	...	...	1	2	3	6	...	...	...	...	...	...	
1925 S.	...	...	1	1	1	4	...	..	...	...	...	...	
A.	...	...	...	1	...		...	.	...	...	...	...	
1926 and 1927	No Record						...	...	...	...	...	...	1927
1928 Spring	...	1	...	2	1	(c) 4	...	...	...	3	2	(d) 5	1928
1929 S.	...	...	...	1	1	3							
A.	...	...	...	...	1		...	...	...	...	1	1	1929
1930	Best Fish 30 lbs.						Not fished						1930
1931	Bad season				1	1	...	...	1	...	1	2	1931
Totals ...	4	6	8	31	23	72	2	...	5	9	9	25	Total
Weights over...	80	70	60	50	40		80	70	60	50	40		

(*a*) Includes 6 fish of 50 lbs. and 3 fish of 40 lbs.
(*b*) The 3 fish over 80 lbs. were all caught by L. Lacy Langley.
(*c*) All caught at the ' confluence.'
(*d*) All caught from the Right back ' Triangle.'
The Mali is far more fished than the N'Mai, being more accessible.

A. M.

26. *List of Fish to be caught in the Mali and N'Mai H'kas.* (Will members of the Myitkyina Fishing Association please add to this list any other species caught while angling for Mahseer.)

Mahseer (*Barbus tor.*) At least six easily recognisable varieties.

The Common
The Thick-lipped
The Black
} The largest varieties.

The Chocolate
The Copper
The Red
} Small mouthed.

Indian 'Trout' (*Barilius bola*). Reported to weigh as much as 5 lbs. but seldom taken over 3 lbs.

Other Lesser Barils occur but do not exceed a few ounces in weight.

Bachhwa (*Eutropiichthys vacha* (Hamilton). Two varieties, up to 6 lbs. Take spoons of any size, also natural bait.

Goonch (*Bagarius yarcelli*). Two varieties, running to over 150 lbs.

'Kalabanse' (*Labeo calbasu*). (Labeo). Up to 30 lbs. or more; occasionally taken on a spoon.

Silund (*Silundia gangetica*). Run to over 20 lbs., occasionally taken. Taken Silund of 15, 23 at the mouth of the Namti H'ka, they run up to 100 pounds and over and are very game fish.

Freshwater shark (*Wallago Attu*).
Pithecanthropus indicus, sometimes hooked when fly fishing.
Other varieties of Fish caught in the Myitkyina District.

Species	*Weight*	*Where Caught*	*Date*	*Bait*
*The Indian Gudgeon (gobius sp.)	¼ lb.	N'Mai Hka (between Ladai and Chipwi)	July	Worm on No. 6 Limorick

* Entry by author.

27. *A few extracts from the (old) Myitkyina Fishing Diaries.*
When to fish. 'My experience has been that the best time for fishing is the afternoon between 2-30 and 6 p.m.' (Myitkyina book, p. 49).

' . . . . it is worth fishing the Mali however dirty the water may be'. (P. 57).

Fly fishing. 'Except in the very cold months all rivers in the (Putao) district yield, probably, "B. Bola, Pakan"; and many an evening can be put in at Lungsawt or the Nam Khamti Zup with a small fly-rod: the "black gnat" is, I think, the most killing fly. Have taken as many as 27 of these small fish in one evening and several times over 20.' (P. 43).

'I have found most of the Salmon Flies, about Lake Trout size and smaller, good, noticeably the "Jock Scott!" also the "Butcher".'

In the *Hukawn Valley.*

'In the winter months in the Hukawn I never caught anything big on a fly, but one can get quite a big bag of tiddlers in almost any stream of an evening. For these small fish I found a touch of red or other bright colour ***with dark wings*** and a fair amount of tinsel, preferably silver, effective.

'Fly fishing for the bigger mahseer commences after about 1st April.

'Generally fished in the evening only and used a single fly.

'My largest on a fly was an eleven pound black Mahseer which put up a very fine fight, landed several five and six pounders.' (With fly.) (P. 76).

Some good catches :—

From the Mali H'ka :—

22-11-16 ... 20 fish weighing 489 lbs. (Langley) (afternoon).
23-11-16 ... 16 fish ,, 387¾ lbs. (Ditto). (P. 38).
14-4-24 ... 12 fish, best 52 lbs. weighing 228 lbs. at Namlang-Ma, Zup. (between 11-30 and 4-30 p.m.).

At the 'Confluence' :—
April 1928, in one day, 5 fish, best 50 lbs., total 142½ lbs.

From the N'Mai Hka :—
September 1929, in three days, 15 fish, best 49 lbs. (Seniku Book p. 218)

From the Namli Hka (from Seniku) :—
May 1903, in 2½ days, 32 (small) mahseer. (Seniku Book, pp. 76-9).

28. *Brief Extracts from the Seniku Fishing Diary.*

Tumpang Zup. 'Fishing at the junction is not much good after the middle of April as the N'Mai K'ha then begins to come down very dirty. The Tumpang is fishable up to the end of May, though the river is frequently unfishable for a day or two after rain has fallen'. (P. 3, 1900).

This is not in accordance with my experience, I should say when the N'Mai comes down coloured, the mouth of these spring fed rivers should be at their best, I think a visit late April, when the snow water is down the Zup should be excellent, until the monsoon breaks. Fish will then collect in the warm clear water of the Tumpang. 'The fishing in the small streams (Namli and Tumpang)' from 26th April to 21st May 1903 was A. I. Between these dates I got in the Namli and Tumpang 75 fish, total weight 415 lbs. My advice to a successor is :—Be at N'Mai—Tumpang jta. with good heavy

tackle and dead bait on 1st February . . . . 'After February the fishing at this big junction seems very poor and in the first half of April and in March the small streams are poor also. Remember that February is the month for big fish——'. (Pp. 84-85).

(The above is not true of zups up stream from Shingaw.) In April 1927 I got 5 fish in half an hour on a visit by cycle from Tanghpae at the Confluence, I punctured both tyres and the rain had made the road impossible; so I chucked and returned. Heavy rain spoilt the trip. The Mali was coloured when I got the . . . . 23, 17, 17, 12, 11.

Chipwi Zup:—'Tried the river on 1st and 2nd November, (1918) but saw and touched nothing. It is obvious that I have missed the Autumn fishing: anyhow in places north of the Tunpang-N'Mai junction.'

'At Chipwi on 13th March I found the temperature of the water of the N'Mai Hka 60 degrees, and of the Chipwi itself 64½ degrees, astonishingly high temperature as compared with 50 of the Chenab river where I killed 11 fish in one day last December.' (P. 182, 1919.)

Conditions:—

'The fish were landed under weather conditions varying to such an extent that there can not be any hard and fast rule about feeding fish.' (P. 203).

29. *Brief extracts from the Myitkyina Fishing Diary.* (1915-31).

Near Putao. 'A nice hack out to Maneu village leaving Putao about noon arriving Maneu 1.15 p.m. Troll 1½ miles down stream to a deep still pool—the river down as far as this only yields Pangyin, but there must be some good fish in this pool. I took one of 57 lbs. out of it and have had several runs from big fellows—right in the centre between the 2 rocks is the place they lie. You can get back to Putao in comfort by 7 p.m. "The Namlang-Mali zup needs no eulogising, it is a first rate spot-get about 50 yards up the Mali and your spoon into that smooth Triangle" if possible.' (P. 42.)

'About ½ a mile above the Kankin pagoda there is a big pool near a lot of rocks—a small pagoda on one of them. I lost a monster here which I had played for nearly an hour. I am certain there are big fish in it.

'Another good spot where I lost a big fish is about a mile below Nam Sati.' (P. 49).

'On the 18th March I caught a 47 lbs. and 60 lbs. in the pool "(Namlang)" before 10-30 a.m. The 60-lber I got on casting where the water begins to gather speed and though I breaked as hard as I could. I could not keep him off the silk backing which broke. As I looked at the end rushing through the rings I felt a tug again on the rod. The end of the line had caught in a snake ring I had put on the night before. I put the rod down hurriedly and jumped into the water and got the line, calling to the Shan to hold it while I put it through the rings and tied it round the reel above the backing. This took about 20 seconds (?) during which time the Shan said the fish had gone, but on reeling in a yard or two I found him still there and eventually coaxed him into slack water. He took more than his 60 minutes to bring to gaff. The line must have given at the very end of his rush and he must have turned because he was in very swift water. Both these fish I got on with a silver-copper 3-inch hog back spoon.'

'Newnkhai, was taken in "Pickthall's Pool" by a fish which took out 250 yards line at first rush and smashed me at the drum. I breaked with fingers on line drum and was badly burnt.

'I have tried "Langley's Pool" many times but have never touched a fish there.' (P. 57).

From the Confluence. 'The N'Mai I tried on three days and had no luck in it; it is so very much colder than the Mali Hka that the chance of doing really well in it is small.'

The 'Confluence':—'I lost a number of strong fish, one of them taking 200 yards of line up stream where I was unable to follow him. I had on also a large fish from 6 p.m. to 7.45, which twice taxed my last few coils of line on the drum of my reel. The main spring broke in his second rush . . . he made another rush for the actual zup, when the reel jammed and . . . lost the fish.

The fish took us 400 yards down stream. This was the heaviest fish I had on. My 75 lb. fish took 40 minutes, and did exactly the same thing.

They all make for the 1st opening into the large still pool behind the large rock island, and if one is run, out to this one can generally expect a good fish.' (P. 69), (1928).

Upper Mali Hka :—(Read the type-written Appendix at the end of the (old, club diary; full of information.)

'Pickthall's pool. or "The" pool. Fishable whenever it is possible to get to it, but is at its *best in the autumn.* The easiest way to fish this pool is from the rocks at the head. Cast into the main current and let the spoon swing round into the Pool beware, however, of sunken snags under the bank . . .

'Langley's pool is just below the suspension bridge on the right bank. This has been fished assiduously by many fishermen without any success since Langley's departure . . . His secret went with him'. (Appendix, pp. 3 & 4).

'In afternoon, ... At once taken by a very heavy fish, which sailed away, taking out all but two or three coils of 200 yards of line. . . .' (P. 65. c).

Lengths of time recorded from hooking to landing of fish :—

82 lber.	...	'about 15 minutes.'	(Langley).
86 lber.	...	'about 12 or 13 mins.'	,,
41½ lber.	...	'2 hours.'	,,
59 lber.	...	'1½ hours.'	,,
60 lber.	...	'more than 60 minutes.'	,,
50 lber.	...	'about ½ hour.'	,,

Note.—This almost confirms the weight Cock and Hen-fish run to a reasonable belief and example that the 41½, 59, 60 pounder were Cock fish.

30. *Notes on the Mali H'ka.*—From the point of view of accessibility for fishing, the river is divisible as follows:—

1. From the Confluence of the N'Mai to Tiang Zup, (about 27 miles) the river is within a short distance of the P.W.D. road, which is motorable in the open season, weather permitting.

2. From Tiang Zup to Nawng Hkai :—

Corresponds to about 150 miles of road and is mostly sufficiently far from the P.W.D. road to necessitate pitching a camp.

3. The vicinity of Fort Herts. (Putao) :—

The confluence near the Inspection Bungalow at Nawng Hkai, 13 miles from Fort Hertz, is the best water, but other places have been fished with success in the neighbourhood.

Facilities etc. for fishing the most easily accessible stretch of river from Myitkyina: (viz. 1 above):

Transport :—From October to May motor cars and vans traverse the road. During the Rains, only bullock carts and pack animals can be utilised.

Accommodation :—Inspection Bungalows, furnished, with crockery and cooking utensils, exist at Weshi (33rd mile). Nsopzup (42nd mile) and Tiangzup (55th mile).

Boats, etc. :—Sometimes can be hired at the Kwitao Ferry, 2 miles downstream from Weshi. The only certain means of having a boat in this section is to hire in Myitkyina and send it on ahead. Kachins will make rafts locally but they are of little use.

Supplies :—Should be taken out from Myitkyina, as only a limited number of fowls and eggs can be obtained on the spot.

Good fishing water :—

From *Weshi* 'dak' bungalow :—

Downstream :—For 4 miles to the 'Confluence' is fairly fast running with few rocks, pools or bends. Good fish have been landed, (*a*) at Kwitao, (*b*) from the Triangle side, from the rapid above the Confluence. A boat is very useful here.

A large freshwater shark has been caught near the Weshi bungalow.

Upstream :—The Hpungin confluence, where fish other than mahseer have been landed on the sandy spit on the downstream side of the Hpungin Hka, as well as *Barbus tor.* A boat is not essential.

From Nsopzup, downstream from 2 miles from the bungalow as far as the Hpungin zup, 4½ miles by road.

Upstream :—disappointing for 2 miles, after which there is good water up to Njip zup, 7 miles by road.

There is a deep pool at the Njip confluence, from the top of which is a rapid, good fish have been taken.

Tiangzup :—Upstream :—The river leaves the road here and it is not easy to get more than a mile or so upstream.

From a mile upstream down to the head of the rapid half a mile downstream, including the Tiang zup, is good. This confluence has given up numbers of small fish, and several mahseer over 40 lbs. have been grassed just above the rapid.

Two miles downstream towards Njip zup (6 miles from Tiang zup), many fish have been hooked from the Triangle side.

Between Tiang Zup and Nawng Hkai :—

The Mali lies one or more days' march from the P.W.D. road. Few people have had opportunities of trying this stretch, which must include good places for angling. A tent and pawlins a necessity.

The best sport in the Putao area has been obtained from *Nawng Hkai* Bungalow.

MALI HKA

Actual Distances from Polymetrical Tables (1930)

Myitkyina	to	Mankrin	5	miles	*	
,,	,,	Watugyi	19	,,	*	
,,	,,	Confluence	28	,,		
Mule Road :—						
Confluence	to	Weshi	3½	,,		
Weshi	,,	N'sop zup	7	,,	*	
N'sop.	,,	Njip zup	6	,,		
Njip zup	,,	Tiang zup	5	,,	*	
Tiang zup	,,	Daru zup	10	,,	*	
Daru zup	,,	Waship zup	9½	,,		
Cast Road :—						
Myitkyina	to	Alam	12·5	,,		Total distance from Myitkyina :—
,,	,,	Chinghran Hka	21	,,	*	
,,	,,	Weshi	33·1	,,		
Weshi	,,	N'sop zup	8·7	,,	*	41·9 miles.
N'sop.	,,	Tiang zup	13·1	,,	*	55· ,,
Tiang zup	,,	Supkaga	9·0	,,		
Supkaga	,,	Kadrangyang	11·5	,,		
Kadrangyang	,,	Kawapang	9·0	,,		
Kawapang	,,	Tingpai	10·3	,,		
Tingpai	,,	Maitkon Hka	12·0	,,		
Maitkon Hka	,,	Wasat Hka	14·8	,,		122·6 ,,
Wasat Hka	,,	Machega	6·0			(to Sumprabux) 7·2 ,,
Mule Road :—						
Wasat Hka	to	HpunginHka	16·6	,,	*	138·2 ,,
Hpungin Hka	,,	Hpunchan Hka	10·9	,,	*	149·1 ,,
Hpunchan Hka	,,	Tutuga	11·1	,,		
Tutuga	,,	La-awn-ga	7·0	,,		
La-awn-ga	,,	Masum zup	13·8	,,		
Masum zup	,,	Hkamho	13·0	,,	*	(Namlang, etc.)
Hkamho	,,	Nawang Hkai	12·5	,,	*	(Namlang) 205·5 ,,
Nawng Kai	,,	Fort Hertz	13·0	,,		(Putao) 219·5 ,,

31. *The N' Mai Hka.—*

Accessibility :—From November till May, (weather permitting) by motor car and light lorry from *Waingmaw* via. Nausaung (11 miles) to Seniku (32 miles). The Namyin-Namlao Hkas at Wausaung are not worth fishing.

* The better fishing spots marked.

From *Seniku* (good Inspection Bungalow), the confluences of Namli and Tumpang streams can be reached on foot within an hour, and the Tumpang confluence with the N'Mai is then best arrived at by bamboo raft. All necessary information can be obtained from the Fishing Diary (1900-31), kept in the Dak Bungalow.

Beyond Seniku, Pack Transport or coolies must be resorted to. Only a very few of the latter are available near Seniku.

If the Tumpang area proves disappointing, move on to:—

hingaw, not a bad spot.

Then on to *Tamu Zup*, the best angling place on the left bank of the N. Mai.

Give Tanga Hka a miss; poor for fish; a paradise for biting insects.

Chipwi Zup, 49 miles from Seniku, is very variable; the Maru's poison the water above the bridge on and off in the spring and autumn, thus making spinning at the Zup a waste of time.

General:—Virtually no supplies available anywhere. Bring up everything from Myitkyina. The occasional chicken and a few eggs are all that can be expected.

Include a rifle, tiger are quite plentiful and have taken quite a lot of mules etc., within shouting distance of Tenga, Tamu and Chipwi 1. B.S.

From February to November, a sandfly net and plenty of 'Flit' are essential: (From November to February the fishing is a wash-out, anyway, at Chipwi and upstream from there).

The N'Mai is less reliable than the Mali for Mahseer; a very rough general guide as to seasons is:—

Spring:—Seniku; end of February till the first big rise of the N'Mai, (which may be in March).

Tamu confluence; second week of March till beginning of May.

Autumn:—N'Mai and Tributaries:—Odd periods of a couple of days or so between the second week of September and the first few days of November.

After heavy rain, the Tamu Hka be expected to clear sufficiently for spinning within 36 hours; the Chipwi Hka does not clear for 3 or 4 days after a downpour.

If leave is short, previous application to the A/S. Sadon, for a raft to be made ready near Seniku (and at Shingaw) and for cooies, if required, is (or advisable).

Where to Fish in the N'Mai Hka.

(with rough sketches).

(Maps of the Mali Hka are to be found in the Myitkyina Club Fishing Book).

(1) From a Raft, drifting down the { *Tumpang* Hka. / *Namli* Hka. } to the Tumpang Zup. In the N'Mai a mile below the Tumpang Zup.

(2) Shingaw Hka and Zup. and small fish; vide sketch.

(3) *Tamu Hka* and Zup. Good for both large and small fish; vide sketch.

(4) 37th mile (from Seniku). 3 miles from Tamu I.B.

(5) Laima Zup. From Chipwi I.B. (5 miles by P.W.D. route, 3½ miles by short cut.

(6) Chipwi Hka and Zup. Vide sketch.

(7) Any other small zup.

(Reference maps 92 G/14., and 92 K/1.)

32. *Notes by P. W. Finch on the Fishing in Myitkyina*:—

'1931, At the Mali Hka and the Confluence, and in the N'Mai Hka was a bad year, and 1932 so far giving no sign of being a better one. There was one 60 lbs. fish caught in the N'Mai Hka in 1931, and one of 40 lbs., each in the same river and at the Confluence.

In 1932, W. caught fish of 38½ and 40½ lbs. in the Mali Hka, and J. was lucky enough to get two of 12 and 14 lbs. at Alam Village.

The Governor's party recently working really hard for 3 days, managed to get a 9-pounder.

R. T. who did very well before here, has just come along for a month's fishing and it will be interesting to see what he gets. I will make a point of letting you know when he comes back.

There is a very good camp at the Confluence now. Run by the Fishing Association, I am enclosing a copy of the new rules for your information.'

Also the Myitkyina Association Club Rules.

No note received.

33. *Myitkyina Fishing Association.*

It was decided at a meeting at the Myitkyina Club to form a Myitkyina Fishing Association. Every year many keen fishermen visit Myitkyina for the mahseer fishing in the Mali and N'Mai rivers and particularly at their Confluence 30 miles from Myitkyina.

A very comfortable and picturesque camp has recently been built at the Confluence and it has been decided to maintain this as a permanent fishing camp if sufficient funds are forthcoming.

There must be many keen fishermen in Burma who have been deterred from coming to Myitkyina to fish owing to the difficulty of obtaining information as to the places to fish and the difficulties of transport and bandobast.

With the advent of motor cars and lorries at Myitkyina the fishing is within easy reach. At the meeting Lt.-Col. A. Lethbridge, I.A. was voted to the Chair.

His Excellency Sir Charles Innes, K.C.S.I., C.I.E., I.C.S., Governor of Burma, has very kindly consented to become Patron of the Association.

After discussing the question of ways and means it was decided :—

1. That the Association should be run in connection with the Myitkyina Club.

2. That the Annual Subscription should be Rs. 10 for all members of the Association.

3. That the camp at the Confluence should be maintained and a small fee should be charged to members making use of it.

4. That the Honorary Secretary, Myitkyina Club, should be *ipso* (this is not the case at Keduent) *facto* Honorary Secretary of the Fishing Association and would supply members with all information and arrange for hire of boats, etc.

5. If sufficient support is obtained it will be possible to extend the activities of the Association so that members wishing to fish localities further afield will then be enabled to do so with as little inconvenience as possible. The present proposals cover the Irrawady and Mali Kha from Myitkyina to the 55th mile on the Putao Road.

6. Donations to give a start to the Association will be of great assistance.

Myitkyina, (*Sd.*) *Honorary Secretary,*
April 5, 1930. Myitkyina Club.

34. *T. P. Dewar's Notes.*—
Putao and Myitkyina.

T. P. Dewar, Esq., writes on the 'Best Time to Fish in the 14/4/28 Putao District'. Also on the Confluence.
12/4/32. Notes on the Chindwin District.

'Best Time to Fish in the Putao District.'

Your query as to which is the best time to fish in the Putao District April and May and again September and October. The Fishing during these months is absolutely dependent on the climate conditions. One can only be absolutely certain of clear water in November and December, January and early February. During these months one catches fish but has to work a good deal. Personally I prefer fishing in the winter to any other time of the year as there are no bugs and it is ever so much pleasanter.

'I shall be interested to know the result of your fishing. I am inclined to think, with the dry weather we have been having, that the snows will have melted and that you will find the confluence too discoloured. Don't forget to sink your spoon deep and get down to the big ones. You ought to do better in the Uyu, though I don't think you will get any thing over 30 lbs. in that stream. Your small rod ought to come in very useful. If you have time try the Mogaung R. from Wakawng. There are some lovely pools, and I have seen some very big fish up to 50 lbs. It has been a very good year in

the Hukawng, but I was away in the Naga Hills for the best time. However I had a few afternoons in the Tarwg, my biggest landed being 40 lbs. I lost several other big fish, Hardy's special mahseer hooks snapping in the first big rush. Have been using the fly and have had good times. Here too I have had several weeks with big fish up to 10 lbs. I have just come back from a village where I lost five, however I landed fifteen, biggest $2\frac{1}{2}$ lbs., two others $1\frac{1}{2}$ lbs. each. Its great fun using light tackle and a fish weighing 5 lbs. feels like a monster and makes a small reel sing. I wish I had a 16-ft. salmon rod with a $4\frac{1}{2}$ reel, I am sure I could have accounted for many a 15-20 lb. fish with fly this season.'

12-4-32. *Notes on the Chindwin District.* 'You will see that I am in the Chindwin area and I have much to say about this river, one of the very worst for fishing. The feeders are just as bad. I have just returned from a trip up the Uyu which rises from the Jade mines. Myitkyina District. A splendid stream for mahseer in these higher reaches but where it enters this District hopeless. I used a fly exclusively but took nothing beyond a one-pounder, and even this was not a mahseer. I only caught two tiny mahseer in the Uyu and was told by the local people that they do not exist. I believe it to a limit, so few it may well be said that in these lower clay bottom reaches they are non-existent. I have really never made any lengthy notes except it be the killing of a 37-pounder mahseer and an 85-pound turtle on a victor rod (7 oz.); and a remarkable experience which befell a companion fishing with me in the Mole R. Bhamo District. He hooked a one-pound mahseer on a salmon fly and out of the depths suddenly arose several long and hungry shadows the largest of which seized and swallowed that one-pounder the reel hummed for a space. My companion was so taken aback that he shouted out for instructions but these were unnecessary so hung on tight and after a while the fish came out again and the big feller got off. Not quite Jonah and the whale as if I recollect weight Jonah had much to say after his experience whereas the one-pounder looked as if he had had an experience with a threshing machine. Were these and other similar experience in your book I am afraid your reading public would fling the epitaph "Liar" after you. I am getting quite garrulous but then this is only possible while writing to you; were you before me now I expect I should be considered a very good listener. On this last trip I tried for bison but was unfortunate to hurt my leg before getting to the ground with the result that I lost one fine bull and could not get up to another and had to leave a herd of 30 odd alone. In that area I heard of one of those freaks of nature which occur in a decade. An albino bison the lord of a large herd. He has been frequently seen. I did not have the pleasure of seeing him, but should I be here next December I shall see what I can do. In the meantime I have reported the matter to the powers that be.'

Chapter VIII.

Mahseer Fishing in Assam and the Dooars.

Varieties of Mahseer and other sporting fish in Assam (1), Goalpara and Kamrup districts (2), Darrang district (3), Lakhimpur and Sadiya Frontier Tract (4), Sibsagar district (5), Nowgong district (6), Garo Hills (7), Sylhet and Cachar (8), Lushai Hills (9), Manipur (10), Peacock's account of Sarasati—Garo Hills (11), Laour on Puna Teet—From The Angler's Hand Book (12), Notes by Gyles Mackreel (13), Anonymous account on Darrang district (14), Notes on Cachar by Mr. Cooper (15), Further notes on Cachar by Mr. Ewing (16), Notes on Manipur (17), Notes on dark variety of Mahseer (18), Fairweather's notes on Mahseer in Bengal and Assam Dooars (19), Notes by Mr. O. M. Martin (20), Mr. Ritchie's notes on fishing the Teesta river (21).

Assam is a province of hills and mighty rivers, and is, with Burma, the best suited for mahseer in the Indian Empire.

It is intersected from the north-east to the south-west by the great Brahmaputra, which takes in along its course the many fine tributaries from the north, rising in Bhutan, and those rising in the Garo, Khasi, Rengama, Naga and Patkai hills from the south.

Further south, the Barak or Surma with its many smaller tributaries drains the districts of Cachar and Sylhet, all good mahseer water.

It has not come within my good fortune to fish in this province, so I am unable to offer any first-hand notes. I had hoped to solicit the aid of one of the resident anglers, to write a chapter on the excellent fishing enjoyed by the local community, but my attempts failed. So that what should have proved to be one of the most interesting chapters of this book, must now simply be the compiled notes of a few fishermen, who have so generously contributed notes within their own experience.

The hill tracts are almost entirely given up to tea growing, and have in consequence a fairly large European community of planters, amongst whom are a number of keen anglers. Some of the best rivers are protected or leased by clubs, so that before anyone intends visiting the water, he should first of all make full enquiries, and get the goodwill and permission of the local club.

From correspondence I have had, it would appear that unless one did this, or had a friend to help, it would be difficult to get to the best water, as boats and transport are almost impossible to obtain, the best places being considerable distances from rail and road head. The fishing, though excellent, has become a monopoly of the local community, and it would hardly be worth while undertaking a long rail journey, for any but those fortunate in having friends to help.

I am indebted to Mr. Giles Mackreel for the excellent plate of the teeth of the mahseer, with his interesting notes and photos of fish. He records similar types of mahseer from Assam, to those listed by me, in the Burma chapter, pt. V. His notes on the teeth of the different types of fish, are both interesting and instructive. I am also most grateful to Messrs. Cooper and Ewing for their interesting notes covering years of experience. It is interesting to note how the opening up of the country has affected the fishing in certain rivers, over a period of years. I also thank the gentleman who has sent me the note on fishing at Darrang, but who prefers to remain anonymous.

Last but by no means least, I have to thank Mr. Inglis for allowing me to reproduce here certain articles from his excellent journals of the Darjeeling Natural History Society.

I have listed for convenience, and purely by the aid of the Gazetteer, the districts with the larger rivers in them. Perhaps if this book runs to a second edition, anglers will correct or send me up-to-date notes on water within their own experience, so that I can include them in a chapter on Localities.

1. *Varieties of Mahseer and other Sporting Fish in Assam.*—The Mahseer in Assam attains a great size, and appears in many varieties, or more correctly in conspecific forms, as we learn from Dr. Sunder Lal Hora's interesting articles 'The Game Fishes of India' in the *Bombay Natural History Society's Journal*, Vols. 41 and 42.

Besides the Mahseer, the Bokar (*B. hexagonolepis*) frequents most of the rivers, and affords excellent sport on fly, with the sporting little *Barilius bola* (Indian Trout) and the Butchwa; besides these all the big Silurids are represented, common amongst which are the Goonch, Silund, *Wallago attu*, and Tangra. In the tanks the Rohu, Mirgil, and Catla are taken, along with the Murrel in his weedy haunts.

2. *Goalpara and Kamrup Districts.*—In the west the Gadadhar river bounds the district, and is formed by the two Bhutan rivers, the Raidhak, and Muchu. The Goalpara district is further intersected from north to south by the Champamati, and two other smaller rivers (names of which are not available). The Manas is a stream of considerable size and is snow-fed, and must be excellent up in the hills and at junctions with feeder streams.

'A number of rods go up the Manas each year, and usually have good results. But others are doing immense damage.'

3. *Darrang District.*—The Dhansiri is a stream of considerable size and must have excellent water in the hills. The Bhareli is a snow-fed river that joins the Brahmaputra in this district and in size is equal to the Manas.

'Mahseer are to be found in the Boanuddy which is the boundary river between Kamrup and Darrang. They are found in large pools in the gorge near the Bhutan border. They are also found in the Borelli near Tezpur and the Manas. In the latter rivers they run up from 40 to 60 lbs.'

4. *Lakhimpur District and Sadiya Frontier Tract.*—N. Lakhimpur itself is on the Ranga, and about 10 miles from the hills.

'Here two rods fishing caught a 50 pound Mahseer on Xmas Day on a No. 8 spoon.'

Further east the Subansiri, a large stream, flows through the district and is fed by many large tributaries in the Miris country.

'This is a very fast river and contains some huge fish. I got a 26 pounder in March and then my boat was upset in a rapid, and I lost all my rods and tackle. Two Europeans have been drowned in it, in comparatively recent years. There is a forest bungalow at Dabing Mukh, and a number of rods go up every year. Silvery and beautiful.'

Further east we come to the Sadaya frontier tracts which have probably the biggest water in the province, and where enormous fish lurk in the waters of the Dihang Sesiri, Dibang, and Luhit rivers.

'The Dihang is really the upper water of the Brahmaputra, huge fish can be seen in some of the gorges, but there are sheer cliffs to the water's edge. The water is not cold.'

In the south or left bank the Noa Dihang and Buri Dihang join in, with the Disang and Jhamdi.

5. *Sibsagar District*.—The Dhansiri is the largest river flowing through this district, and should offer good sport above Dimapur on the A.B.Ry. Besides this there are other smaller streams that provide sport with small fish.

'Notably the Doiang which can be joined from Jamguri station A.B.Ry.'

6. *Nowgong District*.—The Jumna which rises in the Rengma hills has provided excellent sport with small fish, also the Kapili. Lumding is a convenient railway station for this water, from where trekking must be done.

7. *Garo Hills*.—There are a number of rivers that rise and hold good fish in these tracts. Chief among which are the Krishnai which flows north and the Bhogi, Kangsa and Someswari which flows south. All excellent Mahseer rivers (from old notes).

8. *Sylhet and Cachar*.—The Surma or Barak, with its tributaries, drains these districts and affords excellent sport in the higher and jungly reaches to the members of the fishing club at Silchar, who lease the river from the Government to protect it from poaching. This club protects the Loobah, Barak and Jumtrapai rivers.

Sunamganj is on the Surma, and it is from near here that Laour is reached on the Punateet. (See notes from *The Angler's Hand Book*.)

9. *Lushai Hills*.—Here some excellent rivers run and very good fishing is to be had almost without exception in the Dheleswari, Sonai, Tipai, Kaladan and Langai Rivers (but no recent notes are available).

10. *Manipur*.—Good sport can be had with fair sized fish, in the Barak, Northern Hills; in the Thopal Eastern Hills; and in the Chakai Southern Hills. Large Mahseer are to be had in the Barak and its larger tributaries the Idang and Makru in the Western Hills.

'The largest fish taken in recent years was a 56 pounder, caught by me (Gyles Mackreel) on a Myitkyina Macdonald spoon, in December 1928.'

The Manipur river itself rises in the north of this state, and after running into a large lake (Loktak Lake) flows south and out of the State into the Chin Hills and Burma.

Besides the rivers I have mentioned there are many others of which only local knowledge can assist, and the ways and means of getting to them, must of necessity be obtained locally.

The notes in parentheses are by Mr. Gyles Mackreel, and the note on Boanuddy by J. L.

11. *Recent Notes on fishing and localities in Assam and the Dooars by F. Peacock, Esq.*

'Garo Hills, 36 miles north from Mymensingh railway station. River Sarasati near a place called Durgapur, the best fishing to be had about 22 miles from Durgapur between two villages, Ryuk and Seejoo, and about 2 miles beyond the latter place. The water is well known in the neighbourhood. The best way to reach the water is by rail from Calcutta to Goalundo, 8½ hours; thence by steamer to Narayangunj, 10½ hours, thence by rail to Mymensingh, 7 hours. From Mymensingh to Durgapur is a road good for driving part of the way and for riding the whole way. The place was visited in February with good results. In 1877, 48 fish, weighing 877 lbs., or over, an average of 19 lbs. per fish, were killed by two rods in 3½ days all Mahseer. The best way to fish is with a spoon, from a boat moving. On hooking a fish it is best to land and play him from the shore.'

12. *Laour, Assam from 'The Angler's Hand Book'.*—'The river is called the Punateet and runs out of the Khasia hills at Laour. To get to it, you have to branch off at Sunamgunge (on the Soormah) and go by boat to a village called Elamgao; here you can get dingies and boatmen to take you up the gorge, where you must rough it in a grass hut. It is a beastly unhealthy place. Every time I go there all my servants are knocked over with fever. I got it once, but on that occasion I was there for 6 weeks.'

'Extracts from my Diary :—

'November	19th	got	nil,		lost 4 fish.
,,	20th	,,	1,	lbs.	19, lost three.
,,	21st	,,	2	,,	30, 36.
,,	22nd	,,	6	,,	46, 31, 41, 25, 13, 12.
,,	23rd	,,	2	,,	44, 30.
,,	24th	,,	2	,,	24, 32.
,,	25th	,,	nil,		gave the good pools a rest, and tried some new water.
,,	26th	,,	3	lbs.	18, 58, 55.
,,	27th	,,	3	,,	29, 29, 62.
,,	28th	,,	8	,,	16, 54, 20, 33, 7, 32, 33, 26.
,,	29th	,,	2	,,	28, 26.
,,	30th	,,	1	,,	28, tried new water again.
December	1st	,,	1	,,	21.'

Col. H. S. Wood writing in the Journal of the Darjeeling Natural History Society, Vol. VIII, No. 1 of the June issue of 1933. 'When I left the Military I was fortunately posted to Sylhet. In this district Ommaney, mentioned in Thomas' "Rod in India", made his fabulous bags of Mahseer. I soon found out the best places, they were the Ponatite at the N.W. corner of the district where the river debouched into the plains through a lovely gorge in the Sunamgunj sub-division. I shall never forget my amazement, when I

* Probably means the Someswari.

first gazed on this fisherman's paradise. There was a huge pool, several hundred yards long, now and then I saw the red fin of a Mahseer protrude above the water and the *Chilwa* scuttled along the water as one of those fish rushed for them.'

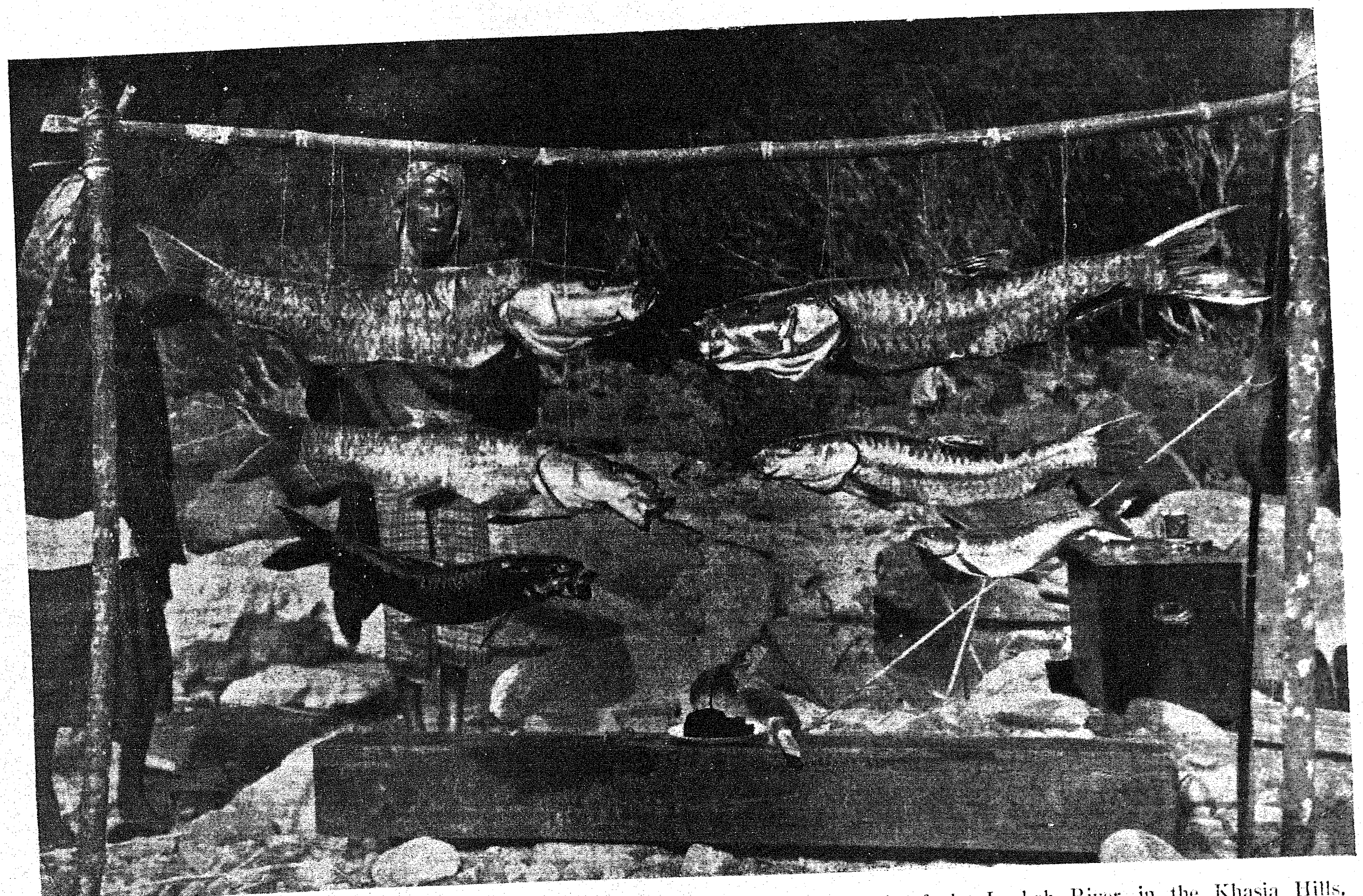
'Consequence was that after each mighty rush, traces and line gave way and I lost all my fish and most of my spoons. I threw away the remainder of that tackle and ordered a new lot from Hardy, Manton and Luscombe. On my next visit to this place I got some nice fish and secured a Goonch (*Bagarius yarellii*) of 67 pounds with which I had great fun. This Ponatite was a fascinating place. In the higher reaches the cliffs rose abruptly from the water's edge and the rocks assumed all sorts of fantastic shapes. On some of them I noticed writings in Urdu and visited a wonderful cave, full of bats. The higher reaches are difficult for boats as there are rapids, up which a dug-out cannot pass. There is also no path along the edge to reach the pools beyond, a folding boat is of no use, so the Mahseer is safe in those higher pools. Hard by the Ponatite is the Tangour Haor, which at one time swarmed with Sambhur, Hog-deer, Pig, Buffalo and Tiger, but like all places in India the game has been decimated by Zamindars, and slaughter during heavy floods.'

'Mr. Gyles Mackreel writing of this River, points out that the course of time appears to have changed the name of the Ponatite. He writes "I think this must be the 'Gohairi' or the 'Piyain' of modern maps."'

13. *Notes by Mr. Gyles Mackreel.*—'The only rivers I have fished personally are Loobah, Barak & Tepi, Kinshyiang, Goomra, Toorsa, Jaldacca, Malangi, Soobansiri. The Loobah runs up into the Khassia Jaintia Hills, past a tea garden of the same name. As the fish pass up and down there is fair fishing in the lower reaches, but the Mahseer all make for the top, and in Oct. and Nov. one will hardly get a fish down below, as those that are going down have gone, and the ones remaining are three days' journey up into the hills. I have been up several times and my best fish is a 32 pounder. They run larger, as I have found two of the short gilled variety killed by Otter which must have been over 50 lbs when fresh as they weighed nearly that putrid. You will see, the gills are far shorter than the common Mahseer. My theory is that it is a bottom feeder that lives, when large, on crabs and large water snails as the teeth are quite different to those of the ordinary Mahseer. I am having a photograph made to show this difference and will send it to you. Is it a big carnatic carp?† I have caught these up to 15 lbs. but never bigger. In Assam the carp is called the Boka. It fights very well indeed. In Cachar and Sylhet they call it the *Maugri*. The Mahseer being the *Mahoal* and the variety of Mahseer I have marked X being the *Pukki ranga*. This latter fish is (your copper fish?) deep and thick. It does not seem to go above 20 lbs., or at any rate

* Between Mr. Peacock's note, and Col. Wood's it should be possible to locate the famous spot, and further notes prove interesting. Neither the 'Gohairi' nor the 'Piyain' is mentioned on my maps.

† This is *B. (Tor) tor* (Hamilton). The common grey normal type is *B. Tor putitora*, as identified by Hora.



Typical long-gilled Mahseer caught on Xmas Day 1930, in the Singlar, a branch of the Loobah River in the Khasia Hills. Note the Black Mahseer in the left corner, and the Carnatic Carp or 'Mangi' in the right corner.

25 lbs.	23 lbs.
20 lbs.	18 lbs.
12 lbs.	6 lbs.

(Note the Xmas pudding on the rod cases.)

to take a spoon when over that weight. It is a beautiful bronze above, with red fins. The one in my photograph has thick red lips, but I have caught a fish that seemed exactly similar but with ordinary lips. I have found that the Carp all have teeth similar to those in the big fish on the unprinted film, i.e. one huge molar and the usual number of small teeth, the older the fish the more these teeth are ground down. In the *Pukki ranga* the teeth are the same. In the ordinary Mahseer the teeth are sharp, even in big fish. This I think points to the diet, fish and vegetable matter very largely in the ordinary long, gilled Mahseer, crustaceans, etc., in the case of the others. (The lips enlarged through turning over stones in search of Crabs, etc.?) Huge short gilled fish are occasionally caught on *atta* in the Brahmaputra at Amingaon and Gauhati. One caught last year weighed 90 lbs. This was the *Boga pitia* or white Mahseer of the Assamese as distinct from the *Lal pitia* or ordinary (red) common long gilled Mahseer. What the *Boga pitia* is like when small I do not know. I have never caught a big one; and when small he may be the Carp or the *Pukki ranga* both of which are rather like your Chocolate Mahseer.'

'I am going off on a two months fishing holiday in Oct.-Nov. and will then send you, or the Bombay Natural History Society, whichever you like, skins of the various types. I will simply take the insides out and stuff them with salt and straw. I will of course send the description of the colour of the eyes, etc.

'Loobah. This river runs into the Khassia-Jaintia Hills. On entering the hills one comes to a huge gorge pool some three quarters of a mile long. This is full of huge rohu, etc., but I have never taken a big Mahseer out of it although it looks ideal. Upstream from this pool the river ascends the hills in a series of rapids and pools. About 8 miles into the hills it becomes the Lunar. The latter forms a series of lime-stone pools and rapids and has no very big fish in it in the cold weather. The other branch, called on the map the Luka but locally the Singlai, dries up at the junction for a matter of some three quarters of a mile, as the river enters a cave higher up and flows under ground for that distance, joining the Lunar and the Loobah under the surface of the latter. This means that fish that have not passed over this barrier while it is still under water in September, remain above for the whole of the cold weather. There are some fine pools, but otter are very plentiful, and the fish get killed off as the water drops. The best fishing is therefore as soon as the water clears in October. Carp are very plentiful and take a fly readily. One rod took 39 fish in one day, nearly all on fly and averaging about 4 lbs. My best bag, fishing with a No. 7 spoon was 13 fish in two days averaging 11 lbs. At that time one could have got a very large numerical bag by the use of a yellow spider or small fly spoon as the smaller fish were taking very readily. I took one coal black Mahseer weighing 11 lbs. The tips of the fins were gold.

'The Kinshyiang is the name given to the Jadhukata where this river enters the Khassia Jaintia hills not far from the border of the Garo Hills. This river had not been fished for some years when I went up it at Christmas 1931. This was the worst time to go as the lower reaches had all been poached, and netting was in progress

8

in the upper reaches, when I got there. I have applied for Government protection for this river. I found one good pool where the poles for netting were lying ready. It was full of good Mahseer and on Xmas Day and Boxing Day, with the temp. at about 39° and the water like ice, I got 11 fish averaging 20 lbs. the best fish was 41. There were some very large fish to be seen but I had not got any dead bait and could not get hold of any, and I was fishing with spoon all the time. A No. 7 gave the best results, heavily leaded to get to the bottom. All these fish were the ordinary long gilled red finned mahseer. They fought well.'

This river is difficult of access and I used 100 gals. of petrol getting there and back in a motor boat; and one is liable to get all the way there and find the pools have been cleaned out by poachers. The Subansiri is a direct tributary of the Brahmaputra in North Lakhimpur. It is fished by the Local Government Officials and by Planters in Assam. It is very fast and contains some large fish. One has to hire dugouts from the local Miris who are far from trustworthy. On my last trip some of these experts upset a dugout in a bad rapid and I lost all my rods and reels and a 12 bore gun. Mr. Aitken of Tezpur, a well known Assam sportsman, hooked a huge fish the following day but it broke him after 40 minutes without having shown itself. The lower pools of the river are rather a favourite fishing ground for people who want to fish in comfort, as there is a forest bungalow on the river bank. The fish are therefore quite used to all kinds of baits and spoons being trailed from behind a boat and act accordingly. The fishing trips seem to become river picnics. Knowing this I thought I would try something that the fish had not perhaps seen recently so I mounted 3 six inch fish in a spinner so that they appeared to be swimming in echelon together. The result was a 26 and a 16 pounder in half an hour from water that 7 rods had been fishing a few days before with no result. A fluke? Probably. But worth trying again.

The Toorsa and Jaldacca are both Dooars rivers. The typical Dooars Mahseer seems to be golden brown backed, silver belly, and orange or pale lemon fins. A lovely fish. The other fish is the '*Kutli*' which is very much like the Assam carp and is probably the same fish under slightly different conditions. He is like your Chocolate mahseer to look at but only goes up to 10 lbs. I am told. My best is 8 lbs. I will send you a picture of one, side by side with a Mahseer. He has the flattened teeth of the carp.

The Barak is a finished river. Poached from end to end. Two years ago 500 Lushais came down and netted and poisoned all the pools within a few hours of Silchar, dried the fish and went off into the hills again. Ichabod! The river used to be full of magnificent fish and my best bag was thirty pounders and a number of smaller fish in one day.

'The last time I went up I got one four pound fish, and the trip entailed 8 days leave and cost about Rs 300.'

'The Malangi used to be good but the Toorsa has now cut into it and all the shingly pools are now sand and the fish do not stay. The Goomra is a small river in the Cachar hills parallel with the Kalain. It holds fish up to 8 and 10 lbs. in the late rains, but in the cold weather there is nothing big to be taken.

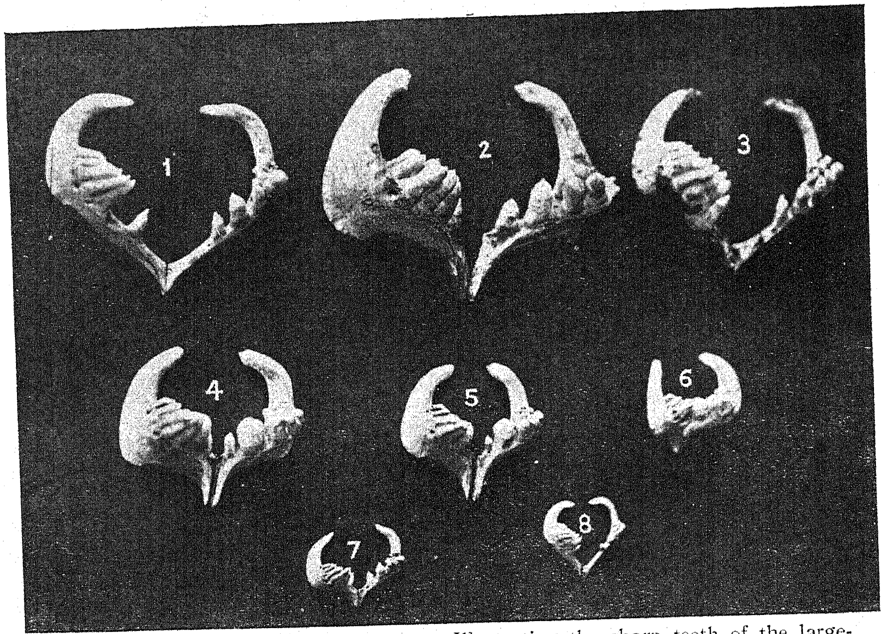


Fig. 1.—Teeth of Mahseer in Assam. Illustrating the sharp teeth of the large-headed variety, and the blunt teeth of the short or small-headed variety.

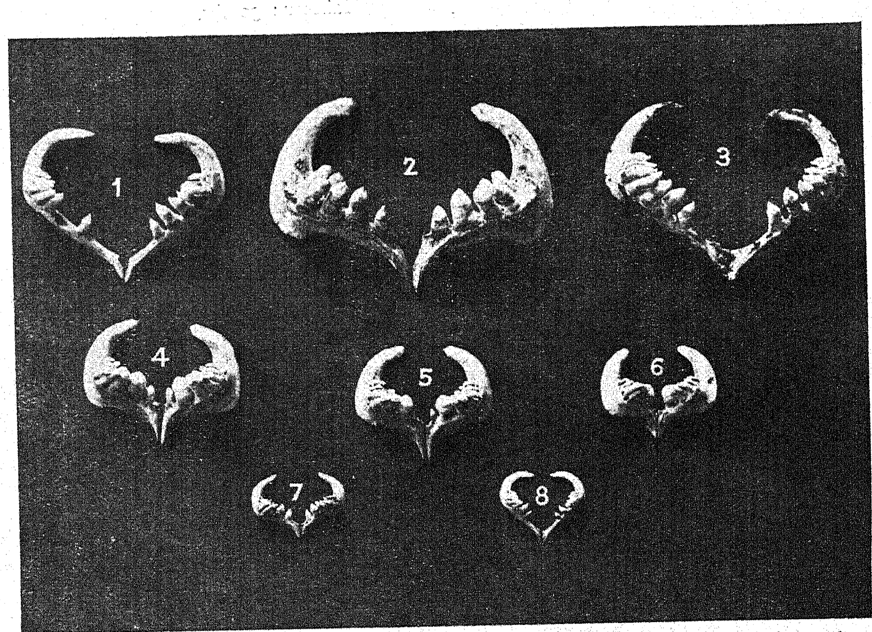


Fig. 2.—Variation of the teeth of the varieties of Mahseer in Assam, as observed by Mr. Gyles Mackrell. (The short gill or small heads have blunt teeth. The long-head or the ordinary variety stand alone in sharp pointed teeth.)

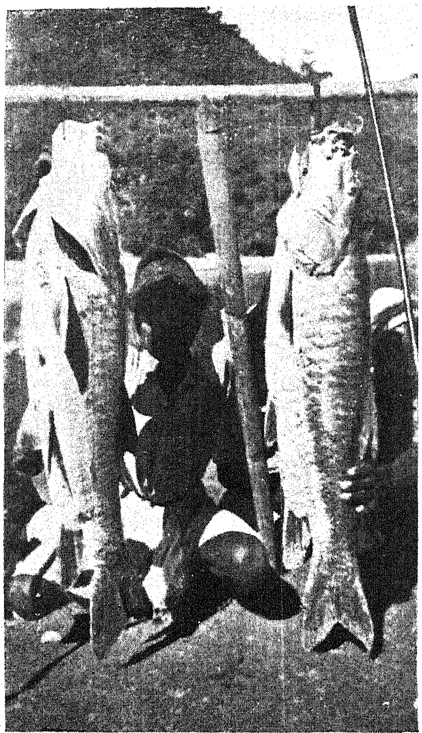


Fig. 1.—Two ordinary Barak Mahseer: 30 lbs.

Fig. 2.—The Barak record: 56 lbs.
Length $49\frac{1}{2}$; Gill $29\frac{1}{2}$.
A snap out of Mr. Cooper's Notes.

Fig. 3.—Short gill Mahseer: 30 lbs.
Cachar and Sylhet: 'Pukki Ranga'
Flattened Teeth.

'I am afraid this is very disjointed but I will endeavour to write you more later. The Manas is one of the famous Assam rivers. It is in a game reserve and a special permit is required. I am going up this year but as yet I have no first hand knowledge of it. It is a direct tributary of the Brahmaputra, like the Rydak and Sankhos.

'5-8-'32 I send you some photographs of fish teeth. The point is that the long-gilled Mahseer seems to stand alone as far as teeth go. He is the only one with the *sharp* teeth. The big short gilled fish (I sent you a film of a 50 pounder and I took a photo last month of a 64 pounder but it was in a part of a cine picture and I have not had a print made yet) the short gilled fish has blunt teeth with the one big molar. The carp or *Cutli* of Assam, the Dooars and Sylhet (Assam, *Boka*, Dooars *Katli*, Cachar and Sylhet *Maugri*) all have the blunt teeth. So has the copper fish and the thick lipped fish. The black Mahseer (simply a melanic example of the true long gilled variety) has teeth, scales, etc., exactly as the ordinary coloured one. By black Mahseer I mean *black*. You will see one in one of my pictures.

'I was talking to a man who came down the Manas recently from the upper reaches in Bhutan and he tells me he watched them catching Mahseer there with strips of a scaly gourd off the trees. He was not a fisherman, but he had photographs of the fish. I have caught them on a scaly spoon but seldom.

'Up the Sonai, Cachar, one fisherman finds the best thing to use is a No. 8 spoon with a treble mounted on a 7 in. length of gimp. The shank is bound with a little red wool. The fish come short at the spoon in gin clear water and seem to suddenly see the little red thing spinning at the end of it and go for it. I have tried it once and caught a fish, but personally I prefer my treble in the centre of my spoon and one flush with the end.'

14. *Darrang, Assam.—By an Angler who prefers to remain Anonymous*, 7-6-'32. Darrang, on the north bank of the Brahmaputra holds some very fine rivers, and water can be found to suit the taste of any fisherman. Tezpur is the only town in this district and is approached by a daily service of river mail steamers up and down the Brahmaputra from Amingaon; these steamers continue up stream past Tezpur, touching at various Ghats or Mukhs, to the terminus Kokilamukh; reference will be made later to the various Ghats at which the intending visitor should disembark should he wish to visit a particular river. I would say at the outset that it is useless to come to this part without a full camping outfit. Stores can of course be obtained in Tezpur, and there is ample accommodation to be had either in the *dak* bungalow or the floating residential flat at Tezpur ghat. From this temporary base, the intending fisherman would have to make arrangements to approach the Bhoroly river, which is the largest in Darrang; I would advise him; in fact it is essential to write to the Political Officer, Balipara Frontier Tract, Charduar, Lokra P.O., which is some 20 miles from Tezpur, informing him of his desire to fish and shoot on the Bhoroly. As a matter of fact a Fishing and Shooting Association is in the process of formation in this district, and should it become a going concern, the Political Officer would put the visitor in touch with the Secretary. In any case the next move should be to Charduar from where a 'political' road runs for 22 miles into the foot hills practically along

the banks of the Bhoroly. Either of the above gentlemen would help the visitor to obtain dug-outs, without which it is useless to attempt to fish this river. One boat for each fisherman is definitely necessary, for which he will have to pay at least Rs. 3 per day; the Miris who work and hire the boats are very knowledgeable as to the best water and times to fish; also as regards the game, which at certain times is plentiful in this part; I should make it clear that after leaving Tezpur, which can be done by rail to Balipara, within a few miles of Charduar, the party should be entirely self-supporting and camping out will be the order of the day, as there are no *dak* bungalows or shops in this direction, after Tezpur. The way, *par excellence*, of working this part, or the whole of Darrang for that matter, would be to bring a car, preferably with a trailer for baggage; every river would then become accessible, especially the Bhoroly, as the 'political' road is always in excellent order, the fisherman is then completely independent of that terror in Assam, and probably elsewhere, the *gharry-walla*. I strongly urge this course to be adopted should any one think of a fishing trip in Darrang. Presuming the party to have safely got into camp on this river, with the requisite number of boats, they will find plenty of good pools wherein the only method of fishing is by trolling. Anything up to 60 lbs. (I am speaking of Mahseer), may be expected, while for this a No. 7 or 8 spoon is the usual thing and a local secret is to attach a piece of red wool or ribbon to one's spoon; live bait is also a successful lure. Good spinning water will be found every quarter mile or so. Fly fishing is not much use on this river, but up its tributaries, especially the Namri, a fly fisherman will obtain good sport. I treat on fly fishing separately however as the Bhoroly is essentially a trolling and spinning river, but subsequent remarks on fly fishing, would apply to most of the tributaries. The Bhoroly is affected by snow water after about the first week in May. The best times to fish would be from November on to March. The first month or two I believe to be the best; but the latter period, if not quite so good for fishing, is balanced by the better prospect of seeing game, anything from bison and buffalo down to barking deer may be met with; and if the party hire an elephant, which would be quite possible, some very good big game shooting could be obtained; in any case, a fairly heavy rifle should be part of one's equipment. As all this country is within the Balipara Frontier Tract administered by the Political Officer, his permission must be obtained before any shooting or fishing is contemplated.

'Another typical river of Darrang, also in the Balipara Frontier Tract, and one of which I have far more intimate knowledge, is the Boroi; a small stream issuing from the Daffla foot hills. It is far smaller than the Bhoroly. This again is quite easily accessible by car, either by road from Tezpur, some 55 miles, or by disembarking from the steamer at Gomirighat, but there are no *dak* bungalows worthy of the name, nor is it possible to obtain stores, Tezpur being the nearest place. The Boroi is a delightful river, wooded banks, short rapids, many deep pools, and as one goes up stream, the river runs through beautiful gorges. This river is ideal for fly fishing, both from the banks and more especially from a boat; after a little practice it is quite easy to stand up in the dug-out, and drift down

one of the beautiful gorges casting a fly on the water which laps the precipitous sides. The fish, which I believe to be true Carnatic carp, local name "Boka," can sometimes, when feeding, be seen on the surface, and it is wonderful sport to select a large one and put the fly over him. I have caught up to 16 lbs. on a very light fly rod. You can sometimes see the fish lazily open its mouth and gently suck in the fly, then a quick strike and away he goes. Sometimes these fish take a lure with a rush, but more generally as above described. Then again the rapids hold large mahseer, easily up to 40 lbs.; and some very pretty sport, spinning, with anything from a No. 6 spoon, can be had. A fly spoon in some of the lesser rapids sometimes produces good baskets; altogether the streams in Darrang of this type provide some delightful fishing. December is not a good month for these smaller rivers, I would say late October, if the cold weather has set in early, and November and February-March, especially the latter, as these smaller streams are unaffected by snow water. All through the hot weather good fishing may be had, provided there is no thunder about, which seems to send the fish clean off the feed. As regards fly, No. 6 hooks Limerick scale. The Coachman is a never failing lure, also the Zulu, in fact any sea-trout fly will do, mounted on a Salmon cast, with about 100 yards of line.

'The fishing rivers of Darrang may therefore be divided into two categories, A and B.

A. The Bhoroly, a river suitable for a large party and fairly easily worked, within reach of Tezpur, if the party is provided with a car; and B., the Boroi; a typical example of which I have described, suitable for one hand or at most two, where they must be entirely self-supporting; but again not too inaccessible if the party have a car. It must be understood, although I have not marked them on the sketch map, that the district is thickly dotted with tea gardens, all round Tezpur and east to the Boroi, beyond which there are a few gardens, and the intending visitor may safely rely on getting help and advice from the planters.'

'40 miles further east lies the district of *North Lakhimpur* in which several fine rivers are to be found, but of which I have no personal experience. One in particular, the Subansiri, which is far larger than the Bhoroly, is I believe a wonderful river for large Mahseer. On the whole the Mahseer and *Boka* (Carnatic carp) are the two principal fish to be found in all these rivers; the latter takes fly well, also spoon, the former is essentially a fish to be caught on the spoon, and only occasionally takes a fly.'

'The Bhoroly is a large snow-fed river suitable for a party of 3 or 4 rods, and approached as above described.'

B. 'The Bor Dikrai, although a tributary of the Bhoroly, deserves to be classed by itself, or rather in the Boroi class.'

'Borgang river and its tributary the Dikal. Means of approach either by road from Tezpur or by river steamer to Behalimukh, or Kathnibrai ghat, P.O. Borgang; suitable for 1 or 2 rods, boats not essential but would be very useful. Good big game shooting no *dak* bungalow.'

'The Boroi. Means of approach by road from Tezpur or steamer to Gomirighat, P.O. Halem, suitable for 1 or 2 rods, boats essential; good big game shooting.'

15. *Notes of Fishing in Cachar by Mr. Cooper.*—'Mahseer fishing in Assam Cachar. I have done some little during the last 30 years. My personal experience only extends to one district of Assam-Cachar and before dealing with the headings you have given in your questionnaire—I must explain that there is practically no good fishing to be obtained without making an expedition up one of the various rivers into the hills in Manipur Lushai country. This means that one must have boats and a crew, with outfit and generally the use of a motor boat to cover the lower reaches of the river, if one is to get to one's fishing water in a reasonable time. You will therefore understand that it is difficult for any one not a local resident to make a *bandobast* to get to the best water as there are no roads or accommodation of any sort when one gets there. In my young days, the smaller rivers used to provide us with very good fly fishing in October and November and one could reach these on a horse; but increasing population, cultivation, and netting, have made these rivers hardly worth a visit. I will therefore confine my remarks to rivers that I have fished in recent years. Those are the Barak with its tributaries the Jheeri and Tepi; the Sonai, the Loobah—the higher reaches of which are leased from Government at a nominal rent and protected as well as possible by the Surma Valley. Angling Association during the cold weather months.'

'An expedition starting up any of these rivers would have to outfit in Silchar, which is anything from 50-100 miles from the best water. Membership of the Surma Valley Angling Association can be obtained from the Secretary at Rs. 10 per annum. None of the rivers are snow fed.'

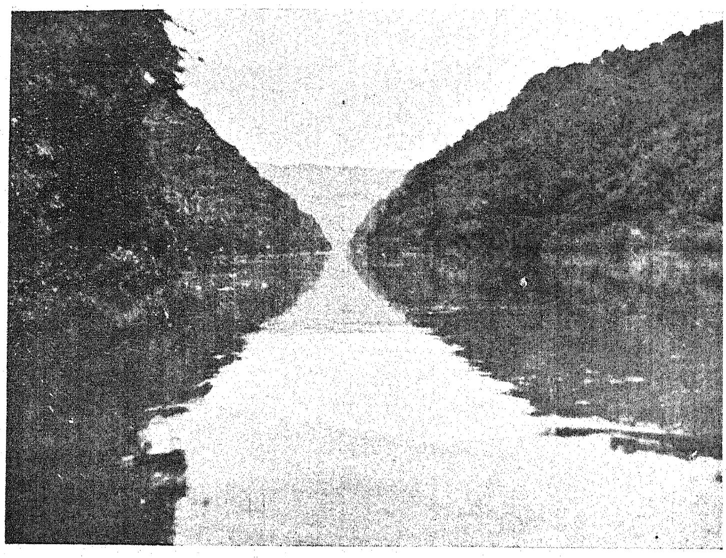
'The Barak holds big fish, which are caught by trolling or spinning—with a dead bait or spoons from No. 7-9. Most of the big fish are caught trolling and one rarely gets anything over 15 lbs. spinning. (Probably because Anglers do not fish deep enough. A. M.)'

'The Tepi is, early in the season, good for fly and small spoons, big fish caught spinning have been rare in recent years. The Jheeri is far the best river for fly—those I have been most successful with Yellow Spider, Claret and Mallard, Blackamore, all large size. Fish up to 15 lbs. are caught spinning. All fly fishing is done from a boat. The Loobah can be reached by boat from the Surma and is probably the easiest to get at, it also holds fish up to 50 lbs. both Spoon and Fly do well at the right time.'

The Sonai. 'Some excellent bags have been made up this in recent years chiefly by Mr. Ewing, the Secretary of the Surma Valley Angling Association. Like other rivers in Cachar one must be prepared to camp and travel 3 or 4 days in small boats before getting into really good fishing water.

'All these rivers fish best as soon after the water clears as possible i.e. November and December—the Barak which is a larger river, I have done well on in February.'

'One can generally shoot enough for the pot in the way of jungle fowl, pigeon, odd duck, an occasional deer and serow. Gharial are still fairly numerous on the Barak. Dense jungle down to the river bed makes stalking impossible. Very unhealthy, and feverish between November and March.'



(1) Opening gorge of the Loobah.

(2) A stone lashed between the jaws of a split bamboo. (After smoothing the edges with a knife). Very useful in 8 or 10 feet of water to rescue a hook from a boat.

'Supplies can be obtained from the Manager, Cachar Club, who could possibly arrange for boats and men; but as you will gather from what I have written before—this is not an easy *bandobast* for any non-resident, or to be undertaken unless one has a month or more to spare.

'There are two or three distinct varieties of Mahseer caught, also what is locally known as a "Carnatic Carp" the *Boka* of Assam. *Butchwa* up to 2 lbs., also take a fly well at times.'

'Bags' Barak. In 1928 two of us landed 51 fish weighing 388 lbs. in five days actual fishing—largest fish 56 lbs., which is a record for the river. In 1931 we only managed to land 35 fish weighing 185 lbs. largest 15 lbs. in about the same time.'

'Jheeri. In 1930 two of us in 5 days actual fishing landed 104 fish averaging just under 3 lbs.—all mine except one 12 pounder were caught on 10 ft. rod, on Flies.'

'I cannot give you any recent "bags" on the Sonai or Loobah. Mr. C. E. Ewing has done very well up the former, but in recent years the Loobah "bags" have been very poor and it becomes necessary to go higher and higher every year to get good fishing, which adds considerably to the expense and time required.'

'I doubt if you will find in these notes much to encourage any one to make an expedition into Cachar for fishing purposes, but trust they will be of some interest to you. I fancy the country and fishing are very much like Upper Burma on the other side of the watershed, but are being ruined from a fisherman's point of view by increasing population.'

16. *Further notes on the Cachar District by C. E. Ewing, Esq.*, 3-5-'32.—'My personal experience only extends to one district of Assam-Cachar and I have only experience of fishing one small river, the Sonai, a tributary of the river Barak. Mr. W. E. D. Cooper, I understand, is writing you regarding fishing prospects in other rivers in Cachar of which he has had considerable experience, so I will confine myself to the Sonai river which I know best. Before dealing with the details of the Sonai river, I would like to say that good fishing is only obtainable by several days journey up the river from Silchar and no organisation exists whereby outsiders can receive help in arranging boats, crews, etc.; and boats are essential, as no other means exist whereby one can reach the fishing waters. With the increase in population more land is being opened up along river banks, which means that one has to go further and further up the rivers each year to reach good undisturbed fishing water.'

'The Sonai is a small river rising in the Arrakan Hills, its course South to North, when it eventually joins the river Barak at Sonai Mukh, 12 miles from Silchar. This river suffered badly during the severe floods in 1928, from landslides but is improving again gradually. The best time of the year for fishing is between the months of November and February; during the rains the river is high and extremely muddy. I have had very good sport indeed on this river for several years. Dense jungle growing down to the river bed makes fishing only possible from a boat. Fly fishing, with Yellow Spider, Clavet and Mallard, and Blackamore, and underhand casting with spoons (Nos. 7 and 8) have been found to

be most successful. Being only a small river it does not hold very big fish, the largest landed was a Mahseer of 26 lbs., but several have been caught between 12 and 20 lbs. The only drawback to the river is that it abounds with snags—trees and logs that have slipped down into the river in the course of years, and any angler going up this river must be prepared to lose a lot of fish and tackle, so should have a good supply with him. The biggest bag made was in 1925 when two of us landed 100 fish weighing 550 lbs. in 5 days actual fishing—the largest fish 26 lbs. To an Angler who is not out for big fish lots of sport can be had with fish of 5 to 20 lbs. in the Sonai. The fish obtainable in this river are Mahseer, Carnatic Carp, Butcha and Fresh-water Sole.

'There is also lot of shooting available—jungle fowl and pheasants, pigeon, and duck and deer, both sambhur and barking. I have had very good shooting indeed up this river and can usually secure more than one's requirements every day for the pot. In fact for expeditions up this river take little in the way of stores and rely on success with the gun.

'I doubt whether you will find in these notes much to encourage any outsider to make an expedition up this river, but I trust that these notes will be of interest to you.'

'*Locality*. Cachar Rivers. Silchar is the jumping off-place for all of these, viz. Barak, Jhiri, Sonai and Loobah which are the principal protected rivers under the Surma Valley Fishing Association of which Mr. C. E. Ewing of Chingoor T. E., Binnakandy P.O., is Secretary.'

'Barak. This is the largest river and rises in Manipur. Small boats can be engaged in Lakhipur, distance by road from Silchar 18 miles and by river about 50, taking 2 or 3 days for small boats to get there. There is a rest house at Lakhipur, also a post and telegraph office. The best plan is to go by motor car or lorry to Lakhipur taking all kit and stores, which can be purchased at very reasonable prices at the Cachar Club Stores; stay the night in the rest house and start off early in the morning. There are good 'camping places' but it takes 3 or 4 days to get to the fishing parts. Once away from Lakhipur there are no post offices or rest houses. All information can be had from the Secretary of the Cachar Club. The best months for fishing the river are November to February.'

'There are large Mahseer in this river and the record Mahseer was about 60 lbs. (Gyles Mackreel's 56 pounder). Most of the pools give beautiful spinning, and the long ones can be trolled as there are few snags.'

'It takes 8 days to get to the Hatti Rocks which is usually as far as boats go, but it is possible to go beyond and the keen man is well rewarded.'

'Jhiri. This is a tributary of the Barak half a day beyond Lakhipur; but the bed is filled up very much with sand and very slow progress is made. It affords excellent Fly Fishing. October and November are the best months, as after that the water is short. The remarks given under Barak about arrangements apply here.'

'Sonai. This is another tributary of the Barak and goes into the Lushai Hills. Good catches have been made and there is

excellent spinning, but is spoilt by the number of Snags. The same remarks apply as given for the *Barak.*'

'Loobah. This is a very interesting tributary of the *Barak* and unsurpassed for scenery. October and November are the months as water is short later on.'

'Boats can be arranged at Loobacherra by the manager of Loobah T. E., Kanaighat P.O. Stores can be provided at Silchar and then kit can be taken by train to Badarpurghat Station and by a 200 maund boat to Loobagnat where fishing boats are arranged.

'Two days up the river the junction of the *Singli* is reached and if there is plenty of water the Singli will give good fishing.'

'The Loobah is blocked by large rocks and the scenery is magnificent: both tributaries go into the *Cassiya Hills.*

'There is good Fly Fishing to be had, chiefly Carp on "Yellow Spider".'

'Mahseer and Carp are the only fish in these rivers except a very occasional trout. Any kind of spoon will do.'

17. *Notes on Manipur,* 13-4-'32.—A correspondent from Manipur State writes as follows:—'I am afraid I am not a fisherman and cannot give you much assistance.

'There are no really big rivers in Manipur. Small "*Boka*" Carp (Assamese name) and a few Mahseer can be caught in the Barak (Northern Hills), Thoubal (Eastern Hills), and Chakpi (Southern Hills), and in some of the tributaries of the Barak in the South Western Hills. Best bait fly, small spoons or dead bait. Large Mahseer can be had in the Barak, and its larger tributaries, the Irang and Makru, in the Western Hills.'

The following notes are very kindly sent to me by the Curator of the Darjeeling Natural History Museum (Mr. Inglis) from his excellent journal.

These interesting notes deal with most of the varieties of fish to be taken, though some confusion arises in expression, by the different contributors, and it is as well to list the correct names of the fish referred to.

(1) The Greyhound type of Mahseer of Assam, my 'Golden Mahseer', is identified by Hora as the Putitora Mahseer (*Barbus tor*) *putitora* (Hamilton).

(2) The short gilled Mahseer as shown in the illustration of 30 lbs., '*Pukki Ranga*' is identified by Hora as the Tor Mahseer *Barbus tor tor* (Hamilton).

(3) The fish known as the *Boka* or *Katli* by some, and referred to as the Carnatic Carp by others, is *Barbus hexagonolopis*, probably my 'Chocolate Mahseer.'

18. *Notes on a dark variety of Mahseer by E. O. S.* (*Journ. Darjeeling Natural History Society*, Vol. VI, No. 2, Oct. 1931).—The sketches show:—(1) The head of an 8½ lb. fish of the dark variety of Mahseer reduced to half size for comparison with the sketches of ordinary Mahseer sent recently. This is a thick lipped fish. (2) An outline sketch to scale (⅛) of an 8 lb. 'greyhound' Mahseer (above), and the 8½ lb. dark fish below.

I compared the dark fish with other Mahseer ('greyhound' and 'ordinary') at the same time (Sankos, 22nd February 1930) and with *Kath.* The impression which this comparison made on me, at the

time, is best described by saying that:—If the dark fish had been compared with a Mahseer alone, it might have been taken for a

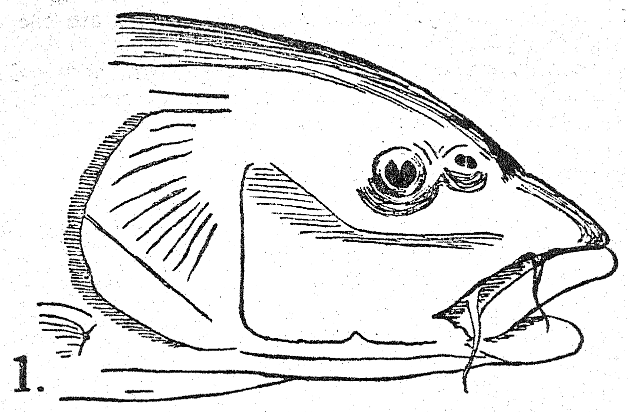


Fig. 27.—Head of Mahseer (dark variety) $\times \frac{1}{2}$. This is a thick-lipped specimen $\times \frac{1}{3}$.

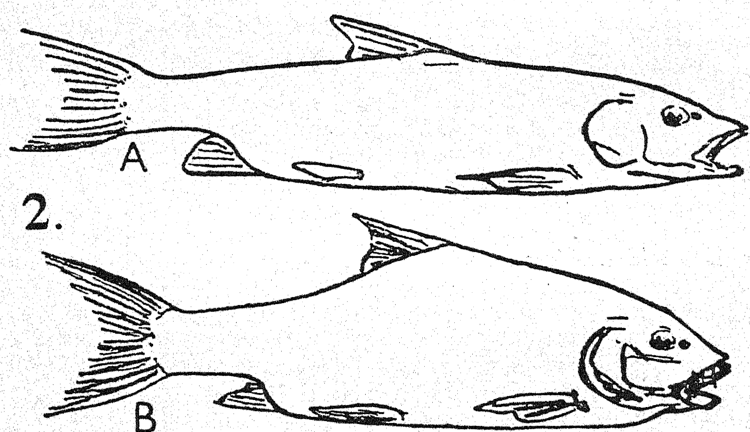


Fig. 28.—*A*. Outline of ordinary Mahseer, 9 lbs. *B*. Outline of dark variety; $8\frac{1}{2}$ lbs. $\times \frac{1}{8}$.
(*Journ., Darjeeling Nat. Hist. Society*, Vol. VI, No. 2, Oct. 1931.)

Katli and if with a *Katli* alone it would undoubtedly have been pronounced a Mahseer. The dark fish, in other words, is in appearance, as nearly as possible, half way between what we believe to be the typical *Barbus tor* and what we believe to be *Barbus hexastichus*.

The dark fish, or this specimen at any rate, was in shape far more like a *Katli* than a Mahseer. The fins were partly the yellow of the Mahseer and partly the slate colour of the *Katli*—the general colour of the fish was intermediate but the eye was golden, as in the Mahseer; only one spot on one iris was copper as in the Katli, but this may have been blood-shot. There were no tubercles on the upper lip.

[1]I do not remember to have seen this variety with thick lips before, and this is one of the reasons which makes me believe that this is a seasonal sexual change. My other reasons are:—

[2](1) That in fish which seem exactly alike in all other respects, the mouth parts of one may be swollen out of all proportion.

(2) That, I think but am not sure, I have only seen these thick-lipped fish caught late in the season from February onwards. O'Donel, however, says he has caught them in the Nunai River as early as November.

(3) That thick-lipped fish usually have a lot of red on the fins. This apparently does not apply to the dark variety.

[3]That the swelling is not uniform in different thick-lipped fish. The lips are always thickened but in some fish the swelling extends to the snout while in others it seems to affect the lower lip more, causing a sort of flap of flesh like an imperial. A still more pronounced type, which I have never seen myself, has these flaps apparently on both lips, as shown in one of the illustrations facing page 32 in Thomas' *Rod in India*.

At present I feel that the distinction between what I have called 'Greyhound' and 'ordinary' Mahseer is a far less fundamental one than that between either of these varieties and the dark form—but possibly further observations, on the rivers, may cause me to change my opinion.

I should be very glad of the observations of other fishermen.

E. O. S.

[The head of a 'greyhound' type of fish may be seen on page 89, Vol. IV, No. 4 of this Journal.—Editor].

19. *Mahseer Fishing in the Bengal and Assam Dooars, by C. E. S. Fairweather, I.P.* (*Journ. Darjeeling Nat. Hist. Soc.*, Vol. VI, No. 4, April 1932).—Mahseer have no shaply defined spawning season like salmon and trout. They are, as the late H. S. Thomas (*Rod in India* by H. S. Thomas, I.C.S.) said like the barnyard fowl: they lay their eggs a few at a time and they are never in better condition than when spawning or looking for an opportunity to spawn.[4] It is this search for spawning grounds that regulates our fishing seasons. Mahseer can be caught at any time of the year, provided one knows where they are to be found, but the other important proviso is that in order to catch them the condition of the river must be suitable. It is hardly of any use fishing for Mahseer

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[1] The 'Copper' variety have modified thick lips. See illustration in Burma chapter.

[2] This is the thick lip variety.

[3] I have taken some hundreds of these thick-lipped fish, in all sizes from ½ lb. to 40 lbs., and in every month from Feb. to Oct. from the Mahl River and Jhelum in the north-west along the Himalayas, through Nepal to Burma, but I have never yet seen one with so pronounced an adipose extension, as shown by Dr. Day's plate produced in the 'Rod in India.' The plate of the Thick lip Mahseer in the Burma Chapter is representative, and there is no 'flap' or adipose extension on the upper lip, at least I have never seen one. A. M.

[4] I disagree with Mr. Thomas that Mahseer are at their best while spawning. In late April and May in some rivers, when the main spawn begins, fish will be taken that offer no sport whatever. I say 'Main spawn', because all the varieties of fish are then found gravid.

(except with live bait) unless the water is clear—the clearer the better. Unless one can see the pebbles on the bottom in four feet of water, fishing for Mahseer is likely to be a heart-breaking business.[1] I refer of course to spinning for Mahseer.

The Mahseer, according to such observations as anglers have been able to make, apparently requires certain conditions for spawning.

(*a*) The water should be warmer than that of the usual glacier-fed river.

(*b*) The water should be shallowish and sheltered. In the big rivers like the Teesta, Sankos and Monas the water is cold, even in the plains, for a considerable distance below the gorges. These rivers begin to rise early in April when the snows melt; Mahseer which have found the shallow backwaters among the chars (miles below the gorge)—ideal places for spawning—now find the chars submerged and begin to move up towards the hills, where they find excellent spawning grounds in the various hill streams which have begun to flow again with the early rains. These small streams too are warm, coming off the hot sides of the lower ranges of hills. The fish apparently travel up these small streams to spawn when a spate comes down and drop back to the main river when the spate clears off.

The Teesta. The Mahseer hang about round the mouths of the Sevoke, Kalijhora, Reang and Gill Jhora, which run into the Teesta. There are perennial spawning places. As I said above, fish are there to be caught all the time. The difficulty is to find the water in proper trim. The Teesta itself is foul and unfishable from April until January or February and it remains clear only for a few weeks before the snow water again begins to come down. When, however, there is a break in the rains, the small hill streams clear and where they join the Teesta there is a belt of clear water for a considerable distance before it merges into the Teesta and gets 'sicklied over with the pale hue of chalk'. In this belt of clear water one can catch really good fish. It may happen that one gets a spell of rainless weather in July or August but one can never count on this. The best season therefore is from mid-September onwards, when the rains are beginning to stop and the hill streams are yet still fairly full and clear. The peculiar thing about these large rivers like the Teesta, Sankos and Monas is that away from the mouths of tributaries Mahseer are very hard to find. This is particularly the case with the Teesta but the Sankos and Monas, too, away from tributaries, are almost impregnable except under the most favourable conditions. The fish move upwards as soon as these rivers rise in April and move down again from the end of September. In the early season, March-April, the only mouth worth fishing is Reang. There is sufficient water here to keep the fish. In the September season they are good, i.e. there is enough clear and warm water flowing in the river to attract the spawning fish. As I said before, one can fish all the year on the Teesta but conditions from July to mid-

[1] This has not been my experience, and I am inclined to agree with Mr. Martin, though clear water is of course the best.

September are so uncomfortable and uncertain that few people would care to bother: torrential rain, wet jungle, fever, leeches, etc. and the difficulty of choosing a time when the small stream is likely to clear. For those living at a distance this is impossible.

Fishing these tributary mouths is not very exciting. There is only one spot fishable, and generally out of 12 days fishing one has 5 or 6 blank days. When one gets a fish it is usually a good one and puts up a tremendous fight, aided by the full force of the Teesta current. No flimsy tackle is any good here. One needs almost 200 yards of line—'Y' stout Tiger traces and a stout rod and line. For rod a Hardy's, Murdoch or something similar is about right. Spoons up to 3″ or 4″ seem best, although I have seen some pretty sport on a Castle Connel Salmon rod—gut trace and fly spoon. This latter at Sevoke: at Reang and Kalijhora, however, one needs to hold the fish a bit harder. On a really good day, if two rods get 3 fish from the pool in the morning and perhaps one or two in the evening they have done very well indeed: next day they will probably come back from the river with nothing but a brace of backaches.

The Sankos. On the Sankos conditions are very much the same. There is a bund on the Sankos to the north east of Sankos Tea Estate, where a side stream comes in. Morning and evening one can get 2 or 3 fish and good fish too. About ½ mile below this spot a small overflow runs into the river again and here too a few fish can be had. I have however fished many other pools on the Sankos, where there is no tributary of warm water running in, without finding any traces of fish. Opposite Barabisha there is a tributary which comes in from the Assam side of the Sankos—some great catches have been recorded here, I believe.

The Monas. On the Monas my experience was the same. Away from the streams of warm water running into the big river, fishing seemed a mere waste of energy. Where, however, one did find a good spot with a 'run in', the fish seemed to lie about in shoals—large fish. It is however not much use trying to fish the Sankos or Monas before February unless one knows a place where a good stream of clear water runs in. These two rivers are also not so accessible as the Teesta.

[1]The ideal fishing conditions are:—

(1) A clear sky.
(2) No wind.
(3) Good clear water.

'Wind is the Mahseer fisherman's worst enemy. I attribute the difficulty of fishing these big rivers chiefly to the howling wind, which blows almost ceaselessly down or up the river day after day. On these rivers the wind starts generally about 9 or 10 a.m. and in the most favoured spots one should be on the water just after dawn.

[1] For ideal conditions, yes! ! I took the largest Mahseer I have caught (75 lbs.) during a thunder storm when a gale was blowing.

[2] This occurs in N. India and Burma, too, on the large rivers, but blows down stream in the morning and up stream in the evening. The days are quite often calm. It is known as the 'Dadu'.

The wind starts about 9 or 10 a.m. and does not drop till about 1½ hours before dusk. These last 1½ hours are generally good. From 10 a.m. till 3 p.m. one's best plan is to eat and sleep. To fish is mere waste of energy, as the fish seem to go right down the moment the wind starts.

It will be gathered from the foregoing that I am not particularly enamoured of these big rivers.

The most enjoyable fishing of all is in the smaller rivers like the Jaldaka, Torsa, Rydak, Champamati and the Aie. They all have their peculiarities but they have the advantage of being fishable from the gorges far down into the plains until sand and shingle give way to mud. One can fish with a light rod and fly spoon or use a medium rod—spinning reel and 2″ or 2½″ spoons, or both alternately, wandering down from pool to pool.

The Jaldaka and Torsa. The Jaldaka and Torsa have not fished well for years. This is due, I think, to excessive netting in the lower reaches and poaching in the higher reaches. The fish too are very shy. In the Jaldaka 'Catli' seem to predominate. The 'Catli' (Assam *Boka*.) is of the carp tribe, like the Mahseer. He has a smaller mouth and smaller scales, while the iris of his eye is red and not yellow like the Mahseer's. He takes a fly spoon well.

Some good fish have been taken at the junction of the Jaldaka and Murti above Ramshahi Hat. The Jaldaka was a famous river at one time but nowadays I would never make a special trip there to fish.

The Torsa is a fairly big river and does not clear properly before November. By that time the weather is getting too cold for the best fishing. When one is getting good Mahseer fishing, one is generally in a 'lather of sweat'. If one is not, then conditions are not at their best. The Torsa has not fished well from all accounts since it left its old bed, which runs past Madarihat Railway Station. I have not heard of any one making any good bags for a long time. Mr. Webb of Hasimara Tea Estate, I believe, catches good fish during the rains with a live bait picketed. Spinning of course is impossible at that time. The Torsa can be fished from either Madarihat or Nilpara Forest bungalows.

The Malang. At Nilpara there is a fascinating little stream called the Malangi, where one can have a really good time with a trout rod, fine gut trace and small fly spoons—fishing is not too easy, as the banks are heavily wooded. Surprising bags of fish up to 5 lbs. or over can be made.

The Rydak. The Rydak is one of the best streams I know. It can be fished from Bhutan Ghat (at the gorge), from Dumpara Ghat (on the Jainti-Kumargram Road) or farther down at Teamaree Ghat. It does not clear much before November but excellent fishing can be had from then onwards until the snow water comes down again in April. It holds very good fish up to 40 lbs.—fish of 7 to 10 lbs. are fairly common. In November-December-January, the reaches below Bhutan Ghat are better but when the river level falls in February, March, April, the best fishing is above Bhutan Ghat in the deep rocky pools of the gorge. One requires a medium spinning rod—the best spoon seems to be about 2 ins. or 2½ ins.

The movements of Mahseer in this river are fairly well known, owing to the fishing trap used by the Bhutias. Every year they put a slanting barricade across the river, which allows the water to get past gradually through the slats but keeps back all fish of any size. These soon find themselves at the end of the barrier, where the water is led on to a platform of split bamboo; there the fish are left high and dry. If they are not dry, then the Bhutias, who kill them in thousands, soon see that they are dried and taken up the hill for food. They intercept the fish in this way just after the rains when they are making their way down to the chars and other spawning places. Fortunately for the fish and for other fishermen it is not always possible for the Bhutias to get this trap across in time to intercept all or even most of the fish. Still, the destruction is immense and I consider that the Rydak is beginning to deteriorate rapidly. I cannot of course say how long this fish trap has been used by the Bhutias. This trap is called a 'teep' and there are two places where it is generally located—about 3 miles and 5 miles respectively above the boundary line. This trap, I am sure, has a lot to do with fishing conditions in the Rydak, which fluctuate astonishingly. On my last visit to the Rydak I found no trap at the lower site. I did not know then about the upper site. While I was fishing there a friendly Bhutia came along and told me that 'teep' had been fixed at a site higher up and that none of the big fish could get down below it. He offered to take me to some fine pools above the 'teep' and seemed to think that I was only wasting time below. The Rydak however will always get a certain number of fish from the Monas, into which it flows; the number of fish coming up depends a great deal on the angle at which it strikes the Monas, whether it runs in over shallows or whether it runs into the deep side of the Monas. As these conditions vary from year to year, this is another important reason for fluctuations in fishing conditions.

Till 1923 both channels of the Rydak joined at Teamaree Ghat but in that year the Eastern Channel thrust its way across country directly towards the Monas and threw up a large bank of shingle between itself and the Western Channel. Since then fishing has never been so good. Apparently the mouth of the Western Channel used to provide a better entry for fish. In 1923 the Western Channel almost dried up, so that fish which had dropped down must have found the entrance silted when they tried to get up again. There is a similar case to this in the Isla and the Tay in Scotland. The mouth of the Isla used to present a direct line to incoming salmon and sea trout, and many, if not most, of the fish used to go up the Isla in preference to the Tay.

The mouth of the Isla was then artificially altered, so that nowadays not more than one or two fish seem to enter the Isla.

The Champamati. Another delightful river as we proceed eastward is the Champamati. It is about half the size of the Rydak. It does not clear properly until Christmas. The best months are March and April. Mahseer up to 25 lbs. are caught now and again but the chief sport is got with 'Cutli', which in this river are the finest fighting fish I have met in India. At Ranikhata a 2 in. gold and silver spoon seems best but down below at Gorubasha an all silver 2½ in. spoon seemed to do best. The average for both Mahseer and 'Cutli'

seems to run about 4 lbs. The 'Cutli' spin round at such a rate and twist up mounts and traces so badly that I had to contrive a mount attached to the spoon ring with a swivel. This seems the only effective way of dealing with these doughty fighters. The banks are heavily wooded, and casting is not always easy but some very fascinating fishing can be had with a light rod and fly spoons used with a dressed silk line. Hardy's 11 ft. 'Wye' rod (for Sea trout and small salmon) seems about right for this work. For spinning, the Corbett No. 1 rod is most suitable here.

The Aie. Still moving eastward one comes to the best river of all, the Aie, which provides about 30 miles of the most delightful fishing in a succession of runs and pools. The best of the fishing (about 14 miles) lies in the forest area from the gorge down to Burree Jahr. The water of this stream is distinctly warm. It clears almost invariably from mid-October or immediately the rains cease. It is almost impossible to have a blank day on this river. The fish are not very big—the biggest I have heard of are about 21 and 22 lbs. [Perrée caught a fish over 30 lbs. in a pool known as Perrée's pool —ED.] Later on I will give a few sample catches. The fishing is best in October-November before the cold winds start. If the rains are late one should fish the upper reaches in October-November, as the bigger fish are now down much more than 10 miles from the gorge by then. In February, March, April one must fish either near the gorge and above Dausri or well below Burree Jahr, as the river between Dausri and Burree Jahr disappears in the hot weather completely. Where one starts to fish this river in the hot weather two days spent exploring are not wasted, as owing to frequent changes of bed one can never be quite certain where one is to find the fish. This applies however to most of these Indian hill rivers.

Indian rivers have their good and bad days just like the more civilized streams of the West. All the fish seem to make up their minds at the same moment to stop biting. The theory is that this is due to some sudden deficiency of oxygen in the water. This deficiency may be due to several causes :—

(*a*) Low barometric pressure, which causes a sudden decrease of oxygen.

(*b*) A heavy fall of rain, which washes dead leaves and rotten vegetation into the river.

(*c*) Snow water, which drives out oxygen.

Lack of oxygen paralyses the fish and they simply lie still under stones on the bottom.

In such conditions Mahseer very often leave deep pools and go into the shallows, where the water rushing over boulders and pebbles is slightly aerated. They also lie right up under a waterfall. These observations are purely guess work and are meant only to provide some sort of Rule of Thumb to guide one to likely spots on a 'real bad day'.

When a wind is blowing it is no use fishing on wide wind-swept stretches of river—seek sheltered corners, if they are to be found. As one moves along from corner to corner one can pick up a fish here and there and can spot likely places when travelling up the river which one can fish when conditions are more promising.

Now as regards the kind of sport one can expect. I give below a few extracts from my records :—

Year	River	*No. of days fishing*	*No. of fish caught*	*Total weight*	*Biggest fish*	*Dates*
1919	Aie	23	154	406	20 lbs.	20.10 to 11.11
1920	Monas	19	18	203	37 lbs.	18.3 to 5.4
1921	Teesta	11	11	140	32 lbs.	6.10 to 16.10
1922	Teesta	15	29	179	21 lbs.	23.9 to 7.10
1923	Torsa	15	21	25	6 lbs.	13.10 to 27.10 Water not clear
,,	Rydak	7	33	133	26 lbs.	27.11 to 3.12
1924	Rydak	28	80	236	13 lbs.	(Various dates)
1925	,,	43	94	507	40 lbs. 38 lbs.	19.2 to 14 .
1926	Aie	14	125	280	10 lbs.	24.10 to 5.11
1927	Aie	10	103	353	19 lbs. 9½ lbs.	6.11 to 15·11

Some 8 catches, which would be considered quite good days on the various rivers.

1919—Friday 31st October—Aie (Burree Jahr) 32 fish weighing 89½ lbs. and lot about 20 others.

1924—March (early)—Peddie's Catch—Aie (Hatishar).
(1) Ma —20-5-4-1½-1-1-¾-1¼-6-1½.
(2) ,, —22-21-3-3-3-1-¾.

1920—Thursday-March 1st—Monas—1 Mahseer—37
1 ,, —15
1 ,, —16
1 ,, — 5
1 ,, — 1
Total ... 5 ,, —74 lbs.

1920 Friday March 2nd—Monas
Mahseer—19-19-4½
Total 3 Fish = 42½ lbs.

1921—Sunday October 9th—Teesta (Reang)
Mahseer—16-14
Total 2 Fish = 30 lbs.

1922 Wednesday September 27th—Teesta (Sevoke)
Mahseer—2-4-6-3-1-3-6-4-2
Total 9 Fish = 31 lbs.

1922 Tuesday October 3rd—Teesta—2 hours fishing (Savoke) (afternoon)
Mahseer—18-8-3-2 = 4 fish = 31 lbs.

1923 November 28th—Rydak (Teamaree Ghat)
Mahseer—26-6½-6-4-3-2-1
Cutli—4-3½
Total 10 = 56 lbs.

1925 February 24th—Rydak (Bhutan) (Ghat)
Mahseer—40-38-6½
Cutli ... 3½
Total 4 = 88 lbs.

1927—February 23rd—Champamati [Gorubhasa]
Mahseer—9½-9-4-2-2 } 11 fish.
Cutli— 7-5-4-3-2-2 } 49½ lbs.

1927—November 3rd—Champamati [Gorubhasa]
Caught by Nelson—1 Cutli = 25 lbs.

[This is a specimen Cutli for this part of the world.]

River	*Av. No. of fish caught per day*	*Av. weight of fish caught per day*	*Biggest*
Aie	8	21	20, 17
Rydak	3	11½	40, 38, 26, 16
Teesta	1½	12	32, 24, 21
Monas	1	11¼	37, 21, 19, 19
Torsa	1½	1⅔	6 lbs.

Champamati—My figures not worked out. But in April 1926, 5 rods [Godden, Hulton, Bor, Brunbes, Burke] got 147 fish = 450 lbs. in 4 days. A.L. Godden himself got 67 = 220 lbs. in these 4 days on 73 Victor Rod with fly spoon.

Champati [A. L. Godden]—Best day 17 = 85¾ lbs.

20. *Note on Mr. Fairweather's Fishing Notes by O. M. Martin.* (*Journ. Darjeeling Nat. Hist. Soc.*, Vol. VI, No. 4, April 1932).—I don't agree that very clear water is necessary for Mahseer fishing. All the Mahseer I have caught in the autumn have been caught in water in which the pebbles could not be seen more than a foot deep. When the water got clearer than this, the Mahseer refused to bite. I caught one fish of 12½ lbs. on a spoon in *very muddy* water at Reang this October. I got two fish and lost another at Singla in water by no means clear in the same month. The water should be (1) warm and (2) not too muddy for the Mahseer to see the spoon.

I believe that the Mahseer in the cold weather start to take when the water temperature rises and that a sudden drop in water temperature puts them off their feed at any time of the year.

They also go off condition after spawning—as other fish do. They are in better condition in November than they are in October and are at their best in March-April—at least in the Teesta and Rungneet. They are so vigorous in March at Singla Bazaar that they will on occasion jump out of the water like salmon.

DARJEELING,
16-12-'31.

21. *Mr. Ritchie's Notes on Fishing on the Teesta River. Complete Summary of the Teesta River.* 1909-30. (*Journ., Darjeeling Nat. Hist. Soc.,* Vol. VI, No. 1, June 1931).

Total fish caught	**Average weight per fish. (in lbs.)**
266 fish weighing 2,269¾ lbs., best fish 54 lbs.	8·5

Summary by Localities.

Rungneet-Teesta Bridge portion ...	6	fish	35¾	lbs.,	best	14¼	lbs.	5·9
Riyang Area	133	,,	1,481½	,,	,,	54	,,	11·1
Kalijhora	13	,,	142¼	,,	,,	37	,,	10·9
Sevoke	104	,,	495¾	,,	,,	14½	,,	4·8
Duars and Jalpaiguri portion ...	10	,,	114½	,,	,,	45¼	,,	11·4

Summary by Years.

1909.	4	fish	14	lbs.	best	7½	lbs.
1910.	1	,,	1½	,,			
1911.	3	,,	9	,,	,,	5	,,
1912.	1	,,	32	,,			
1913.	5	,,	19½	,,	,,	6	lbs.
1916.	1	,,	14½	,,			
1917.	2	,,	7¼	,,	,,	4½	lbs.
1918.	18	,,	115¼	,,	,,	14½	,,

Summary by Years (*cont.*)

								Average weight per fish
1919.	46	fish	220¾	lbs.	best	29¾	lbs.	
1920.	7	,,	120½	,,	,,	38	,,	
1921.	47	,,	436¼	,,	,,	54	,,	
1922.	15	,,	160	,,	,,	33¾	,,	
1923.	35	,,	187¾	,,	,,	32	,,	
1924.	6	,,	28	,,	,,	24	,,	
1925.	26	,,	283¼	,,	,,	45¼	,,	
1926.	12	,,	86¼	,,	,,	18	,,	
1927.	6	,,	57¼	,,	,,	16½	,,	
1928.	10	,,	77½	,,	,,	36	,,	
1929.	8	,,	91½	,,	,,	18½	,,	
1930.	13	,,	307¾	,,	,,	39	,,	

Summary by Months.

Jan.	4	fish	27½	lbs.	best	15½	lbs.	6·9
Feb.	17	,,	84¼	,,	,,	13½	,,	5·0
Mar.	40	,,	175¼	,,	,,	14½	,,	4·4
Apr.	33	,,	302½	,,		45¼	,,	9·2
May	15	,,	246¾	,,	,,	38	,,	16·4
June	1	,,	5	,,				
July	3	,,	45½	,,	,,	21½	,,	15·1
Aug.	23	,,	202¼	,,	,,	54	,,	8·8
Sept.	47	,,	343¼	,,	,,	34½	,,	7·3
Oct.	65	,,	747	,,	,,	39	,,	11·8
Nov.	6	,,	39	,,	,,	11½	,,	6·5
Dec.	12	,,	51½	,,	,,	7	,,	435

Summary by Baits.

Spoon	...	236	fish	1,649¼	lbs.	best	54	lbs.	7·0
Natural Bait	...	9	,,	156	,,	,,	40	,,	17·3
Artificial Baits	...	4	,,	71	,,	,,	35	,,	17·8
Atta	...	17	,,	393½	,,	,,	45¼	,,	23·2

Spoon Analysis.

No. 3 or 1 in. size— all silver	3	fish	3	lbs.	best	1½ lbs.	1·0
No. 4 or 1¼ ins. size— all silver	5	fish	12¼	lbs.	best	8 lbs.	
brass and silver	6	,,	3¼	,,	,,	¾ ,,	
	11	,,	15½	,,	,,	8 ,,	1·4
No. 5 or 1½ ins. size— all silver	8	fish	18½	lbs.	best	4 lbs.	
brass and silver	24	,,	71¾	,,	,,	9¾ ,,	
silver and brass	4	,,	20½	,,	,,	12½ ,,	
	36	,,	110¾	,,	,,	12½ ,,	3·1
No. 5½ or 1⅝ ins. size— all silver	3	fish	28½	lbs.	best	14½ lbs.	
brass and silver	9	,,	28¾	,,	,,	13 ,,	
	12	,,	57¼	,,	,,	14½ ,,	4·8
No. 6 or 1¾ ins. size— all silver	14	fish	77½	lbs.	best	12½ lbs.	
brass and silver	2	,,	17¼	,,	,,	12 ,,	
silver and brass	1	,,	11½	,,			
	17	,,	106¼	,,	,,	12½ ,,	6·3
No. 7 or 2 ins. size— silver and brass	8	fish	47¼	lbs.	best	14¼ lbs.	
all silver	3	,,	5¼	,,	,,	2¼ ,,	
copper and silver	14	,,	61¾	,,	,,	7 ,,	
	25	,,	114¼	,,	,,	14¼ ,,	4·6

Spoon Analysis (*cont.*)

				Average weight per fish.
No. 7½ or 2¼ ins. size— silver-scaled and copper ...	2 fish	23¼ lbs.	best 14¼ lbs.	11·6
No. 8 or 2½ size—				
all silver	54 fish	498½ lbs.	best 38 lbs.	
silver-scaled and copper ...	15 ,,	173 ,,	,, 54 ,,	
silver and copper	4 ,,	29½ ,,	,, 14 ,,	
brass and silver	14 ,,	95¼ ,,	,, 25 ,,	
silver and brass	10 ,,	57¾ ,,	,, 11½ ,,	
brass-scaled and silver ...	2 ,,	5½ ,,	,, 4 ,,	
	99 ,,	859½ ,,	,, 54 ,,	8·7
No. 8½ or 2¾ ins. size— all silver	5 fish	45½ lbs.	best 18 lbs.	11·1
No. 9 or 3 ins. size—				
all silver	5 fish	23¾ lbs.	best 9 lbs.	
silver and brass	4 ,,	31¾ ,,	,, 14 ,,	
brass and silver	1 ,,	5½ ,,		
silver-scaled and copper ...	3 ,,	70 ,,	,, 37 ,,	
	13 ,,	131 ,,	,, 37 ,,	10·1
No. 10 or 3½ ins. size—				
silver and brass	7 fish	146¾ lbs.	best 38 lbs.	
all silver	3 ,,	9 ,,	,, 5 ,,	
	10 ,,	155 ,,	,, 38 ,,	15·6
No. 11 or 4 ins. size—				
all silver	1 fish	¾ lb.		
all scarlet	2 ,,	26½ ,,	best 21½ lbs.	
	3 ,,	27¼ ,,	,, 21½ ,,	9·9

Spoon Summary.

Light spoons, Nos. 3 to 7 ...	104 fish	407 lbs.	best 14½ lbs.	3·9
Heavy spoons, Nos. 7½ to 11 ...	132 ,,	1,242¼ ,,	,, 54 ,,	10·2

Best Days.

Oct.	10, 1930.	Riyang.	2 fish of	31 and 24 lbs.
Aug.	23, 1921.	,,	1 ,,	54 lbs.
Oct.	8, 1930.	,,	2 ,,	35 and 12½ lbs.
April	4, 1925.	Jalpaiguri.	1 ,,	45¼ lbs.
Dec.	8, 1925.	Sevoke.	8 ,,	41 lbs. best 7 lbs.
Oct.	14, 1928.	Riyang.	2 ,,	36 and 5 lbs.
Oct.	12, 1930.	,,	2 ,,	24½ and 15½ lbs.
Oct.	6, 1930.	,,	1 ,,	39 lbs.

Recent Fishing.

Result of a month's fishing at Riyang, September 15th to October 14, 1930.
13 fish weighing 307¾ lbs., best fish 39 lbs.
Average weight per diem 10·6 lbs.
Average weight per fish 23·7 lbs.
Total fish hooked—31, or an average of about one per diem.
Number of fish lost—18.
Number of absolutely blank days (no sign)—7.
Best day—55 lbs. (24 and 31). Next best—47½ lbs. (12½ and 35.)
Maximum number of fish hooked
on any one day (not mere rises)—3.

Large Mahseer. Altogether 42 fish of 15 lbs. and over were taken, viz., 54, 45¼, 39, 38, 37, 36, 35, 34½, 33¾, 33½, 32, 32, 31, 30¾, 29¾, 28, 24½, 24, 24, 23, 23, 21½, 20, 20, 19¾, 19¼, 19, 18½, 18½, 18, 18, 18, 16½, 16½, 16, 16, 15¾, 15½, 15½, 15¼, 15 & 15. Of these two (45¼ & 32) were caught at Jalpaiguri and Barnes Ghat, and two (37 & 18) at Kalijhora. The rest were all caught at Riyang.

As regards localities for large fish, Riyang is certainly the best. There are perhaps larger fish at the Rungeet junction, but they are not there at the time the water is clear, at least I have never done any good at that time. In the spring when the water is still clear the fish have not yet come up from below, and by the time the water has cleared in the autumn the fish have passed down. The Rungeet is similar to the Teesta and remains permanently dirty during the high water season. I think it likely that anyone trying this spot in May, June, August and September with atta or live-bait would stand a good chance of booking some enormous fish. The water would always be too dirty for spinning at that time. Heat and rain are also further drawbacks. Nevertheless I believe the biggest fish in the river are to be had there at that time.

Large Mahseer may be occasionally taken at Kalijhora in the autumn, and also at Sevoke in September, but at the latter place it is then impossible to follow the fish down the bank and anything over 15 lbs. will usually clear the reel out and break away. I have been broken at Sevoke in September many times and never succeeded in landing anything big there. Large Mahseer may also be taken on atta at Jalpaiguri and Barnes Ghat during April and the first week in May, and smaller fish at other times. I have never tried there during the autumn.

It is not much use trying for large fish in the hill section of the river during the clear water season. The best fishing is at the mouths of the tributaries when the Teesta itself is dirty and there is a sufficient head of water in the tributary to give a good stretch of clear water in the Teesta below the mouth of the tributary. Large Mahseer should be sought when they are passing down in the autumn, and the largest fish are the last to pass up but the first to pass down. Late spring and early autumn are therefore the best times for big fish.

Summary of Light and Heavy Fishing

					Average weight per fish
Fish under 15 lbs.	224 fish	1,214¼ lbs.	best 14½ lbs.	...	... 5·4
Fish of 15 ,, and over.	42 ,,	1,055½ ,,	,, 54 ,,	...	... 25·1

Summary of the Rungeet-Teesta Bridge portion of the Teesta River, 1909–29

					Average weight per fish
Total Caught					
6 fish weighing 35¾ lbs. best fish 14¼ lbs.				... ...	... 5·9
By Localities					
Rungeet River.	3 fish	28 lbs.	best 14¼ lbs.	...	... 9·3
,, Junction.	2 ,,	5 ,,	,, 3½ ,,	...	... 2·5
Teesta Bridge.	1 ,,	2¾ ,,			
By Years					
1909.	1 fish of 2¾ lbs.				
1918.	1 ,, ,, 3½ ,,				
1919.	1 ,, ,, 12 ,,				
1921.	1 ,, ,, 1¾ ,,				
1923.	1 ,, ,, 1½ ,,				
1929.	1 ,, ,, 14¼ ,,				

					Average weight per fish
By Months					
March.	4 fish	20¼ lbs.	best 14¼ lbs.	... ...	5·1
April.	1 ,,	12 ,,			
November.	1 ,,	3½ ,,			
By Baits					
Spoon	5 fish	33 lbs.	best 14¼ lbs.	... ...	6·6
Atta	1 ,,	2¾ ,,			

Spoon Analysis

No. 5 or 1½ in. size—silver and brass	1 fish of 1¾ lbs.		
No. 7 or 2½ ins. size—silver-scaled and copper	1 ,, ,, 14¼ lbs.		
No. 8 or 2½ ins. size—all silver	2 ,, ,, 12 and 3½ lbs.	... ...	7·8
No. 9 or 3 ins. size	1 ,, ,, 1½ lbs.		

Best Days

March 16, 1929. 1 fish of 14¼ lbs.
April 19, 1919. 1 ,, ,, 12 ,,

Large Mahseer

None.

Summary of the Riyang area of the Teesta River 1918–30

					Average weight per fish
Total Caught					
133 fish weighing 1,481½ lbs. best fish 54 lbs.				... ...	11 1

By Years

1918.	2 fish	13 lbs.	best	7½ lbs.
1919.	24 ,,	122½ ,,	,,	29¾ ,,
1920.	4 ,,	102½ ,,	,,	38 ,,
1921.	31 ,,	358½ ,,	,,	54 ,,
1922.	13 ,,	146½ ,,	,,	33¾ ,,
1923.	23 ,,	146 ,,	,,	32 ,,
1924.	1 ,,	24 ,,		
1925.	4 ,,	77½ ,,	,,	40 ,,
1926.	4 ,,	34¼ ,,	,,	18 ,,
1927.	6 ,,	57¼ ,,	,,	16½ ,,
1928.	5 ,,	56½ ,,	,,	36 ,,
1929.	3 ,,	32¼ ,,	,,	18½ ,,
1930.	13 ,,	307¾ ,,	,,	39 ,,

By Months

Jan.	2 fish	17¼ lbs.	best	15½ ,,	... ...	8·6
Feb.	2 ,,	7 ,,	,,	5 ,,	... ...	3·5
Mar.	21 ,,	98¼ ,,	,,	14¼ ,,	... ...	4·7
Apl.	26 ,,	177½ ,,	,,	32 ,,	... ...	6·8
May	15 ,,	246¾ ,,	,,	38 ,,	... ...	16·4
June	1 ,,	5 ,,				
July	1 ,,	21½ ,,				
Aug.	6 ,,	116¼ ,,	,,	54 ,,	... ...	19·4
Sept.	16 ,,	208¼ ,,	,,	34½ ,,	... ...	13·0
Oct.	43 ,,	583¾ ,,	,,	39 ,,	... ...	13·6

By Localities

Gil Jhora Mouth.	3 fish	23¾ lbs.	best	14¾ lbs.	... ...	7·9
Rilli Mouth.	6 ,,	13¼ ,,	,,	4¼ ,,	... ...	2·2
Riyang River.	14 ,,	19¼ ,,	,,	8 ,,	... ...	1·4
Riyang Mouth. Area	97 ,,	1141½ ,,	,,	54 ,,	.. ...	11·8

		Average weight per fish
Lower Pool and Reach.	12 fish 274¾ lbs. best 39 lbs. ...	... 22·9
Timber Pool near 21st mile.	1 ,, 9 ,,	

By Baits

Spoon	112 fish	980	lbs.	best	54	lbs. ...	... 8·8
Natural Bait	8 ,,	151½	,,	,,	40	,, ...	... 18·9
Artificial Bait.	3 ,,	64	,,	,,	35	,, ...	... 21·3
Atta	10 ,,	286	,,	,,	39	,, ...	... 28·6

Recent Fishing

Please see third page.

Spoon Analysis

No. 3 or 1 in. size— all silver	1 fish of ½ lb.	
No. 4 or 1¼ ins. size— all silver	3 fish 10¼ lbs. best 8 lbs.	
brass and silver	6 ,, 3¼ ,, ,, ¾ ,,	
	9 ,, 13½ ,, ,, 8 ,,	1·5
No. 5 or 1½ ins. size— all silver	1 ,, of ½ lb.	
brass and silver	13 ,, ,, 45¼ ,, best 9¾ lbs.	
	14 ,, ,, 45¾ ,, ,, 9¾ ,,	3·3
No. 5½ or 1⅝ ins. size— brass and silver	2 fish 5¼ lbs. best 4½ lbs.	
all silver	1 ,, ½ ,,	
	3 ,, 5¾ ,, ,, 4½	1·9
No. 6 or 1¾ ins. size	1 ,, of ½ lb.	
No. 7 or 2 ins. size— silver and brass	7 fish 40¾ lbs. best 14½ lbs.	5·8
No. 8 or 2½ ins. size— all silver	36 fish 401¾ lbs. best 38 lbs.	
silver-scaled and copper ...	12 ,, 151¾ ,, ,, 54 ,,	
silver and copper	3 ,, 18½ ,, ,, 14 ,,	
brass and silver	9 ,, 68¾ ,, ,, 25 ,,	
silver and brass	2 ,, 7 ,, ,, 6¼ ,,	
	62 ,, 647¾ ,, ,, 54 ,,	10·4
No. 9 or 3 ins. size— all silver	2 fish 13 lbs. best 9 lbs.	
silver and brass	1 ,, ¾ ,,	
brass and silver	1 ,, 5½ ,,	
silver-scaled and copper ...	2 ,, 33 ,, ,, 23 ,,	
	6 ,, 52¼ ,, ,, 23 ,,	8·8
No. 10 or 3½ ins. size— silver and brass	7 fish 146¾ lbs. best 38 lbs.	21·0
No. 11 or 4 ins. size— all scarlet	2 ,, 26½ ,, ,, 12½ ,,	13·3

Best Days

Oct.	10,	1930.	2	fish of 31 and 24 lbs.
Aug.	23,	1921.	1	,, ,, 54 lbs.
Oct.	8,	1930.	2	,, ,, 35 and 12½ ,,
Oct.	14,	1928.	2	,, ,, 36 and 5 ,,
Oct.	12,	1930.	2	,, ,, 24½ and 15½ ,,

Summary of the Riyang Area of the Teesta River. 1918-30. *Large Mahseer.* Altogether 38 Mahseer of 15 lbs. and over were taken, viz., 54, 39, 38, 36, 35, 34½, 33¾, 33½, 32, 31, 30¾, 29¾,

28, 24½, 24, 24, 23, 23, 21½, 20, 20, 19¾, 19¼, 19, 18½, 18, 18, 16½, 16½, 16, 16, 15¾, 15½, 15½, 15¼, 15 & 15.

The best times of the year for large Mahseer are from the middle of April to the middle of May, when the fish are passing up, and again from the middle of September to the middle of October when they are passing down, and the autumn fishing is decidedly the better of the two. I have had no recent experience of the spring fishing, but there is not much water in the tributary at that time and it is soon eaten up by the Teesta. In the old days there was a good deep pool and run at the mouth, but with the present choked-up mouth it is doubtful whether there would be sufficient clear water in the Teesta, the Teesta itself at that time being dirty. The 54-lber. caught in August was a stray fish and should not be taken as a guide.

The time taken in landing most of these large fish was very much under the regulation time of a minute to the pound. This is usually the case at Riyang, where large Mahseer do not put up the fight that might be expected of them. There is, however, one time in the year when exactly the opposite is the case, and that is during the latter half of September, when the very largest fish appear to be on the move and the water is still high and current swift. Anyone hooking a fish of 30 lbs. and upwards at that time will find it quite the exception to land it. Even an experienced hand will lose two out of three. The beginner has absolutely no chance. I lost quite a number of fish at this time this year (1930), and on one occasion had a fish on for exactly an hour (16-20 to 17-20 on the 23rd Sept.), which took me quite a long way downstream, when the hook broke on my attempting to put on a greater strain, not being able to follow any further, and not having up to then made any apparent impression on the fish. During the whole of that time I never once saw the fish, although I was most of the time opposite and slightly below him, so that he was fighting a very strong current in addition to my pull on him. In September, 1921, I also lost a number of very large fish and had the almost identical experience of having one on for exactly an hour. The period referred to above lasts about a week and occurs in the latter half of September when the water is still high. Once the water falls, a marked change takes place and matters go from one extreme to the other, quite large fish being landed in a disappointingly short time.

Seasons. It should be remembered that this is the hill section of a river, and the fish are mostly 'travellers', Riyang being merely a port of call on their annual voyage up and down the river for spawning purposes. They pass up in the spring during the period when the river begins to permanently rise till the rains are well established; and they pass down again in the autumn during the period when the rains begin to break up till the river has permanently settled after the rains. In the height of the monsoon they are mostly as high up the hill as they can get, and in the middle of the dry season they are mostly in the rapids and pools clear of the hills. It is therefore not much use starting to fish in the spring till the river has become well disturbed from its dry season setting and begun to permanently rise or continuing to fish in the autumn once the river has permanently fallen and become settled. It is also not much

use fishing in the height of the monsoon, or in the middle of the dry season. Fish may occasionally be caught at these periods, but such are not the 'seasons' for the locality.

Reflection on these facts should dispel the not uncommon fallacy that it is no use B fishing one day because A has 'cleaned the place out' the previous day. A fresh lot of fish may have arrived. In fact it will be found that even when the fish are most on the move there are days on which there are practically no fish about. The reason is that those that were there have moved on while a fresh lot have not yet arrived.

In the dry season, however, when the fish have settled in localities mostly clear of the hills for their dry season home, it is of course different. One man can 'clean the place out' for another who follows.

As I have stated elsewhere in these notes the largest Mahseer are the last to pass up in the spring but the first to pass down in the autumn, and the best times for really big fish are therefore late spring and early autumn. Anyone who is keen on beating my 54-lbs. at Riyang is advised to try, either as late in the spring as the conditions will permit (the very end of the spring run is the time) or as early in the autumn as the fish first begin to appear (the very start of the autumn run is the time.) These periods vary a bit with the season. The former is seldom before the first week in May and may even run into the beginning of June. The latter is almost always in September, seldom before the middle of the month, and usually about the third week. As I have said before, the 54-lber. caught in August was a stray fish, which is clear from the fact that it was a female fish with roe and therefore still going up to spawn, and not an autumn fish returning.

Summary of Fishing at Kalijhora Teesta River. 1909–25

								Average weight per fish.
Total Caught								
13 fish weighing 142¼ lbs. best fish 37 lbs.								10·9
By Years								
1909.	2	fish	10½	lbs.	best	7½	lbs.	
1916.	1	,,	14½	,,				
1918.	1	,,	11½	,,				
1919.	1	,,	3½	,,				
1921.	4	,,	26¼	,,	,,	12	,,	
1925.	4	,,	76	,,	,,	37	,,	
By Months								
Mar.	4	fish	28½	lbs.	best	14½	lbs.	7·1
Aug.	4	,,	26¼	,,	,,	12	,,	6·3
Oct.	4	,,	76	,,	,,	37	,,	19·0
Nov.	1	,,	11½	,,				

By Baits

All on spoon.

Spoon Analysis

No. 6 or 1¾ ins. size—								
brass and silver	1	fish	of	12	lbs.			
No. 8 or 2½ ins. size—								
all silver	5	fish	40	lbs.	best	14½	lbs.	
brass and silver	2	,,	10¼	,,	,,	6	,,	
silver-scaled and copper ...	2	,,	17	,,	,,	13	,,	
	9	,,	67¼	,,	,,	4½	,,	7 4

		Average weight per fish
No. 8½ or 2¾ ins. size—all silver	2 fish 26 lbs. best 18 lbs.	13·0
No. 9 or 3 ins. size—silver-scaled and copper ...	1 fish of 37 lbs.	

Best Days

Oct.	3,	1925	1 fish of 37 lbs.
Oct.	1,	1925	1 ,, ,, 18 ,,

Large Mahseer

Two fish of 37 and 18 lbs.

Summary of Fishing at Sevoke, Teesta River. 1913-29

	Average weight per fish
Total Caught	
104 fish weighing 495¾ lbs. best fish 14½ lbs.	4·8

By Years

1913.	3	fish	7½	lbs.	best	4	lbs.
1917.	2	,,	7¼	,,	,,	4½	,,
1918.	14	,,	87¼	,,	,,	14½	,,
1919.	20	,,	82¾	,,	,,	12½	,,
1920.	3	,,	18	,,	,,	13½	,,
1921.	11	,,	40¾	,,	,,	13	,,
1922.	2	,,	13½	,,	,,	9¼	,,
1923.	11	,,	40¼	,,	,,	7½	,,
1924.	5	,,	4	,,	,,	1¼	,,
1925.	17	,,	84½	,,	,,	13½	,,
1926.	7	,,	38	,,	,,	9	,,
1928.	5	,,	18	,,	,,	6	,,
1929.	4	,,	45	,,	,,	14	,,

By Months

Jan.	2	fish	10¼	lbs.	best	6¼	lbs.	5·1
Feb.	14	,,	71¼	,,	,,	13½	,,	5·1
Mar.	5	,,	11	,,	,,	4	,,	2·2
Apl.	3	,,	21¾	,,	,,	11½	,,	7·2
July	2	,,	24	,,	,,	13	,,	12·0
Aug.	13	,,	59¾	,,	,,	13½	,,	4·6
Sept.	31	,,	135	,,	,,	14	,,	4·4
Oct.	18	,,	87¼	,,	,,	14½	,,	4·5
Nov.	4	,,	24	,,	,,	9	,,	6·0
Dec.	12	,,	51	,,	,,	7	,,	4·3

By Baits

Spoon	102 fish 484¼ lbs. best 14½ lbs.	4·7
Natural Bait	1 ,, 4½ ,,	
Artificial Baits	1 ,, 7 ,,	

Spoon Analysis

No. 3 or 1 in. size—all silver	2 fish	2½	lbs.	best	1½	lbs.	1·3
No. 4 or 1¼ ins. size—all silver	2 fish	2	lbs.	best	1¼	lbs.	1·0
No. 5 or 1½ ins. size—all silver	7 fish	18	lbs.	best	4	lbs.	
silver and brass	3 ,,	18¾	,,	,,	12½	,,	
brass and silver	11 ,,	26½	,,	,,	8	,,	
	21 ,,	63¼	,,	,,	12½	,,	3·0

	Fish	Weight	Best	Average weight per fish
No. $5\frac{1}{2}$ or $1\frac{5}{8}$ ins. size—				
all silver	2 fish	28 lbs.	best $14\frac{1}{2}$ lbs.	
brass and silver	7 ,,	$23\frac{1}{2}$,,	,, 13 ,,	
	9 ,,	$51\frac{1}{2}$,,	,, $14\frac{1}{2}$,,	5·7
No. 6 or $1\frac{3}{4}$ ins. size—				
all silver	13 fish	77 lbs.	best $12\frac{1}{2}$ lbs.	
silver and brass	1 ,,	$11\frac{1}{2}$,,		
brass and silver	1 ,,	$5\frac{1}{4}$,,		
	15 ,,	$93\frac{3}{4}$,,	,, $12\frac{1}{2}$,,	6·2
No. 7 or 2 ins. size—				
all silver	3 fish	$5\frac{1}{4}$ lbs.	best $2\frac{1}{2}$ lbs.	
silver and brass	1 ,,	$6\frac{1}{2}$,,		
copper and silver	14 ,,	$61\frac{3}{4}$,,	,, 7 ,,	
	18 ,,	$73\frac{1}{2}$,,	,, 7 ,,	4·1
No. $7\frac{1}{2}$ or $2\frac{1}{4}$ ins. size—				
silver-scaled and copper ...	1 fish of 9 lbs.			
No. 8 or $2\frac{1}{2}$ ins. size—				
all silver	11 fish	$41\frac{1}{4}$ lbs.	best 10 lbs.	
silver and brass	8 ,,	$50\frac{3}{4}$,,	,, $11\frac{1}{2}$,,	
silver and copper	1 ,,	11 ,,		
silver-scaled and copper ..	1 ,,	$4\frac{1}{4}$,,		
brass and silver	3 ,,	$16\frac{1}{4}$,,	,, $9\frac{1}{4}$,,	
brass-scaled and silver	2 ,,	$5\frac{1}{2}$,,	,, 4 ,,	
	26 ,,	129 ,,	,, $11\frac{1}{2}$,,	5·0
No. $8\frac{1}{2}$ or $2\frac{3}{4}$ ins. size—				
all silver	3 fish	$19\frac{1}{2}$ lbs.	best $13\frac{1}{2}$ lbs	6·5
No. 9 or 3 in. size—				
all silver	2 fish	$9\frac{1}{4}$ lbs.	best $7\frac{1}{4}$ lbs.	
silver and brass	3 ,,	31 ,,	,, 14 ,,	
	5 ,,	$40\frac{1}{4}$,,	,, 14 ,,	8·0

Best Days

Dec. 8, 1925 ...	8 fish	41 lbs.	best 7 lbs.
Aug. 18, 1929 ...	3 ,,	31 ,,	,, $11\frac{1}{2}$,,
Oct. 12, 1918 ...	2 ,,	$25\frac{1}{2}$,,	,, $14\frac{1}{2}$,,
Sept. 29, 1918 ...	2 ,,	$24\frac{1}{2}$,,	,, $12\frac{1}{2}$,,

Large Mahseer

None were landed. These fish are usually on the move in the autumn, when the Teesta is high and the fishing is all at the mouth of the Sevoke river and just below. At the end of the run there is a heavy rapid in the Teesta and a crumbling bank, full of snags and covered with jungle. A fish of 15 lbs. and over will usually be able to get into this rapid, when it clears the reel out and breaks away, it being impossible to follow down the bank. I was broken some six or eight times in this way and never succeeded in landing any fish of 15 lbs. and over.

The mouth of the tributary in the autumn of 1930 was much higher up the Teesta than it has been for many years and there is now much more room below the mouth for landing fish, but I did not fish at Sevoke in 1930.

Summary of the Duars and Jalpaiguri portion of the Teesta River. 1909–26.

Total Caught	Average weight per fish
10 fish weighing $114\frac{1}{2}$ lbs. best fish $45\frac{1}{4}$ lbs. ...	... 11·4

				Average weight per fish
By Localities				
Phulbarrie Ferry ...	3 fish	9 lbs.	best 5 lbs. ...	... 3·0
Neora Junction ...	1 ,,	6 ,,		
Barnes Ghat ...	3 ,,	52 ,,	,, 32 ,, ...	... 17·0
Jalpaiguri Ghat ...	3 ,,	47½ ,,	,, 45¼ ,, ...	... 15·0
By Years				
1909	1 fish	of ¾ lb.		
1910	1 ,,	,, 1½ lbs.		
1911	3 ,,	,, 9 ,,	best 5 lbs.	
1912	1 ,,	,, 32 ,,		
1925	1 ,,	,, 45¼ ,,		
1926	1 ,,	,, 14 ,,		
1913	2 ,,	,, 12 ,,	,, 6 ,,	
By Months				
Feb.	1 fish	of 6 lbs.		
Mar.	6 ,,	,, 17¼ ,,	best 6 lbs.	... 2·9
Apl.	3 ,,	,, 91¼ ,,	,, 45¼ ,,	... 30·4
By Baits				
Spoon	4 fish	of 9¾ lbs.	best 5 lbs.	... 2·4
Atta	6 ,,	,, 104¾ ,,	,, 45¼ ,,	... 17·5
Spoon Analysis				
No. 10 or 3½ ins. size—all silver ...	3 fish	of 9 lbs.	best 5 lbs. ...	... 3·0
No. 11 or 4 ins. size—all silver ...	1 fish	of ¾ lb.		
Best Days				
April 5, 1925 ...	1 fish	of 45¼ lbs.		
April 30, 1912 ...	1 ,,	,, 32 ,,		

Large Mahseer

Two fish of 45¼ and 32 lbs.

Chapter IX.

Other Sporting Fish and How to catch Them.

Carnatic Carp (1) Chitrahtu (2), Katli, Bokar (3), Jerruah (4), Olive Carp (5), White Carp (6), Black-spot (7), Malabar Carp (8), Rohu (9), Kala Banse (10), Mirgil (11), Cirrhina cirrhosa (12), Catla (13), Indian Trout (14), Barilius tileo (15), Chilwa (16).

Goonch (17), Silund (18), Mulley or Freshwater shark (19), Tengra (20), Butchwa (21), Eutropiicthys murius (22), Clupisoma garua (23), Seetul (24), Notopterus notopterus (25), Gar Fish (26), Freshwater Eel (27), Thorny Eel (28), Murrals (29), Goby (30), Megalops (31). Brown Trout (32), Rainbow Trout (33).

I have listed in this chapter all the common fish taken on rod and line in Burma and India; giving the familiar or anglicised names followed by the ichthyological names, with a description of each fish.

Actually these fish should be dealt with under two separate divisions—game and semi-game fish, as a large number of those listed are taken while fishing for mahseer or other larger varieties of carp, and to which it is not worth devoting much time when the larger species are available. I mean the smaller carp such as White carp, Olive carp, etc.

I have appended short notes to the fish that are in my opinion worth catching or devoting one's spare time to.

Under Rohu, Murral, and Seetul, for instance, will be found methods of fishing not previously mentioned in any book, but quite worth a trial. The reader will find sufficient detail in this chapter to help him to find and catch the commoner fishes: but I would ask him to bear in mind, that, to what Thomas devoted 78 pages in his book 'The Rod in India', I have condensed in a meagre 19.

The text-figures were originally printed in Day's 'Fishes of India'. Fourteen were reproduced by Messrs Shaw and Shebbeare in their 'Fishes of Northern Bengal'. The blocks used by them were kindly loaned by the Royal Asiatic Society of Bengal to whom the author and the Bombay Natural History Society wish to express their sincere thanks.

The Mahseer I have dealt with fully in the Chapter on Burma, so will not include it again in this list.

SUB-CLASS: *TELEOSTEI.* Bony Fishes.

Order: **Physostomi**

The fresh water fishes of India belong to the Sub-Class of Bony fishes (Teleostei). Most belong to the family of Carps (Cyprinidae) and the order of Sheat-fishes (Siluroidea).

The Carps have no teeth in the mouth, but have scales on the body. The Sheat-fishes have no scales, but have teeth in the mouth.

Family: *CYPRINIDAE.*

This family is prominent in the absence of any sort of peculiarities, but the members are familiar to most people. A great majority of Indian freshwater fishes belong to this family. They have scales on the body but the head is naked. Frequently barbels are present, but no adipose fin is to be found. There is only one dorsal fin with its first few rays closely adpressed and unbranched; the last unbranched ray is sometimes serrated along its hinder margin. Mouth is toothless, but there are teeth in the throat known as Pharyngeal teeth, which may be arranged in one, two, or more series. This family comprises the Carps, Mahseers, Barbels, etc., all of which are game and sporting fish.

Genus : **Barbus**

1. **CARNATIC CARP: Barbus (Puntius) carnaticus** Jerdon.

Vernacular names :—*Poaree candee, Saalcandee, Shellee,* Tamil; *Gid-pakke,* Canarese; *Giddi-kaoli,* Hind.

$$\text{D. } 12\left(\frac{4}{8}\right);\ \text{P. } 15;\ \text{V. } 9;\ \text{A. } 7\left(\frac{2}{5}\right);\ \text{C. } 19;\ \text{L. } 1.32.$$

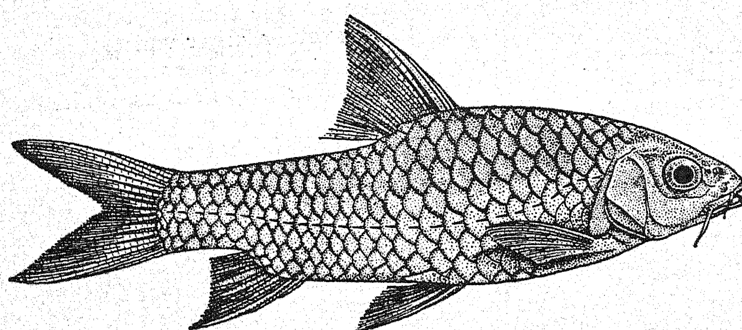


Fig. 29.—*Barbus (Puntius) carnaticus* Jerdon.

Rivers along the bases of Nilghiris, Wynaad and South Canara hills are the common habitat of this fish. The dorsal profile is more connex than the ventral. The upper jaw is larger and the lower labial fold is interrupted. There are two pairs of barbels, both being thin and shorter than the eye. The dorsal fin commences anterior to the insertion of the ventrals and midway between the snout and the base of the caudal fin; it is about $\frac{3}{4}$ as high as the body. Its last undivided ray is a strong and smooth spine, as long as the head in the immature specimens, but sometimes longer in the adults. Pectoral fin is as long as or slightly longer than the head while the anal fin reaches the caudal. The lateral line is complete and there are $3\frac{1}{2}$ rows of scales between it and the base of the ventral fin. The colour

of the fish is greenish-brown along the back, becoming dull white glossed with gold on the sides and beneath. The fins are grayish and the eyes are golden. This fish runs to 25 lbs. and frequents the same water as the mahseer; is taken best on fly. To the inexperienced eye it may be mistaken for a mahseer. They are caught in quiet runs and eddies and back waters between runs, more than in white water of the rapids themselves as in the case of mahseer. Under trees, near sunken logs or swirls, round rocks, are the specially beloved places of this fish. The flies they take best are size No. 5 or 6 in hooks and black or dark. An all peacock fly is probably most killing.

2. **CHITRAHTU. Barbus (Puntius) chillinoides** McClelland.

Vernacular name :—*Chit-rah-too*, Punj.

$$\text{D. } 10\text{-}11\left(\frac{3}{9\text{-}8}\right);\ \text{P. } 17;\ \text{V. } 9;\ \text{A. } 7\ (2/5);\ \text{C. } 19;$$

$$\text{L. l. } 32\text{-}35.$$

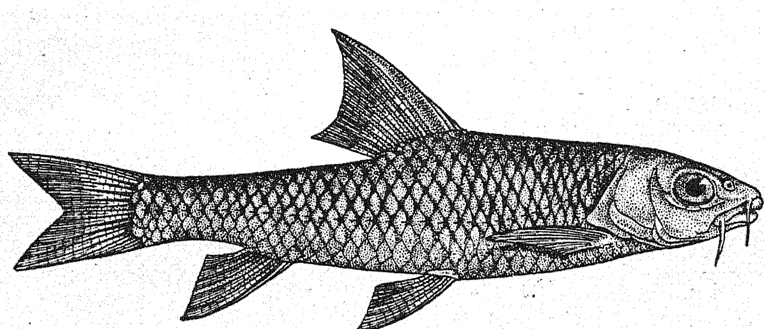


Fig. 30.—*Barbus* (*Puntius*) *chillinoides* McClelland.

This fish is found along the Himalayas as far to the east as Assam, and also in the Ganges. It attains about 2½ ft. in length. The body is rather elongated so that the dorsal and abdominal profiles are about equally convex. The upper jaw is slightly the longer and the snout overhangs the mouth which is directed forwards. The lips are moderately thick, the lower with a continuous transverse fold, but without a lobe. There are two pairs of barbels which are of about the same length and equal to 1½ diameter of the orbit. The dorsal fin commences about midway between the tip of the snout and the base of the caudal fin. Its last undivided ray is osseous, very strong and entire. The anal fin reaches the base of the caudal which is deeply forked. The lateral line is complete and there are three rows of scales between it and the base of the ventral fin. The colour of the fish is golden above becoming silvery beneath. The margins of the scales are provided with numerous fine black dots. A black mark is present behind the opercle. The fins are reddish.

3. **KATLI. Barbus (Lissochilus) hexagonolepis** McClelland.

Vernacular names :—*Bokar* and *Boolooah* Assam; *Katli*, Nepal.

D. 4/9; P. 1/13-15; V. 1/8; A. 3/5; C. 19; L. 1. 22-31.

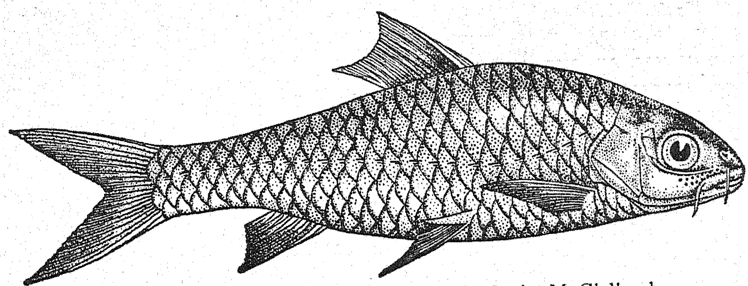


Fig. 31.—*Barbus (Lissochilus) hexagonolepis* McClelland.

This is the Bokar of the Assamese and Katli of the Nepalese. It is also known as the Snub-nosed Mahseer and is perhaps the commonest large-scaled Barbel of Assam and of the Eastern Himalayas. Though Shaw and Shebbeare do not attribute a good size to this fish, it is known to grow to a fairly big size. Moreover according to Mr. S. J. Duncan[1] this is the 'Mighty Mahseer of the region traversed by him and that it was found in almost all the rivers of the Hills'.

This is a beautifully coloured fish, though the colouration might vary considerably according to the nature of the water inhabited by the fish. According to Hora[2] 'The dorsal surface of the head and body was bottle green, the lateral band above the lateral line was yellowish brown followed by an area of King's blue colour which was replaced below by silvery white. The edges of the scales were marked with light bluish neutral tint. The tip of the snout was stone green, and the barbels had a neutral tint. There were two oval patches of a light yellow colour before and behind the eyes; the iris was yellowish brown and the gill cover light alizarine pink. The dorsal fin had a citron green colour, while the pelvic, anal and greater part of the pectoral and caudal fins were of a slate grey colour. There was a patch of buff colour on the pectoral and the margin of the caudal was of a light greenish neutral tint.' In general form this fish is similar to *B. (Tor) mosal*, but the head is relatively shorter and broadly rounded in front. The most conspicuous feature of the head is the possession of several rows of horny tubercles on the sides in front of and below the eyes. Shaw and Shebbeare noted that the habits of this fish are 'very similar to those of the Mahseer. As a sporting fish there is nothing to choose between them, weight for weight. It is unfortunate that, as both take the same lures, and are found in the same water, the smaller species is often taken on much too heavy tackle which does

[1] Hora, S. L., Game Fishes of India, xi, 4. *Journ. Bombay Nat. Hist. Soc.*, XLII, p. 86 (1940).

[2] Hora, S. L., *ibid.*, p. 84 (1940).

not give him a chance to show his power'. I have taken these fish in Nepal as far west as the Girwa River. See 25-pound Chocolate Mahseer in Chapter on Burma, caught by the author, which has been identified by Hora as the Bokar.

4. **JERRUAH. Barbus (Puntius) chagunio** (Ham.)

Vernacular names :—*Jerruah*, Beng. ; *Chaguni*, Behar; *Pootee keintah*, Assam

D. 3/8; P. 15; V. 9; A 3/5; C. 19; L. 1. 44–47.

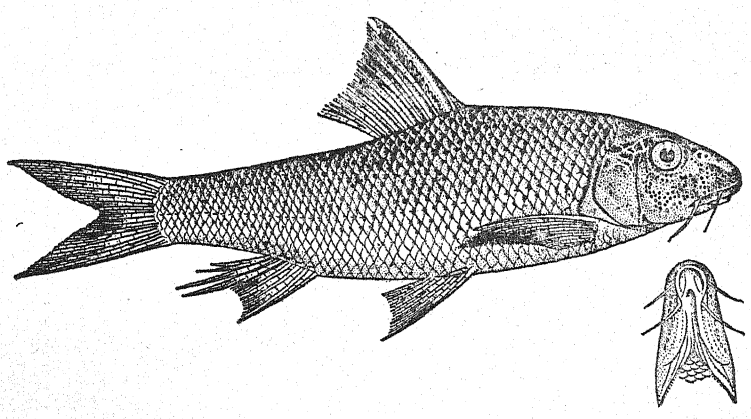


Fig. 32.—*Barbus (Puntius) chagunio* (Hamilton). Male

This fish inhabits clear streams and rivers in the foot-hills, Terai and Duars. According to Day it attains at least 18 inches. The upper profile in front of the dorsal fin is more arched than the lower. The snout is bold and is covered with sunken pores which in males are more strongly marked and more sharply defined. There are two pairs of barbels which are rather longer than the orbit. The dorsal fin arises midway between the end of the snout and the base of the caudal fin. Its undivided ray is osseous, strong with coarse teeth. Some of the last few anal rays are elongated in the males and the species exhibits marked sexual dimorphism. *Colour.*—The fish is silvery with a faint pinkish tinge. A black spot is present at the base of each scale on the upper three quarters of the body. Fins are yellowish, dorsal and caudal with a suffused sub-marginal band of red touched with black. Pelvics and anal are tinged with red. The male is more brilliant throughout and the black fin tips are more marked.

5. **OLIVE CARP. Barbus (Puntius) sarana** (Ham.)

Vernacular names :—*Punjella*, Tam. ; *Giddi-kaoli*, *Durhie* and *Potah*, Hind. ; Gid-pakke, Canarese; *Kanaka*, Telugu; *Sarana*, Ooriah and Bengali; *Jundoori*, Punj. ; *Pop-pree* and *Kuh-nah-nee*, Sind; *Sen-nee*, Assam; *Nga-khon-mah-gyr* and *Nga-chong*, Burmese.

D. 3/8; P. 15; V. 9; A. 3/5; C. 19; L. 1. 32–34.

This fish inhabits clear streams of the foot hills, Terai and Duars, also ponds and borrow pits.

The body is deep and moderately compressed. The dorsal profile is elevated. No pores are present on the snout. The lower

labial fold is interrupted. There are two pairs of barbels; the rostral is as long as the orbit while the maxillary is slightly longer. The dorsal fin arises rather nearer the snout than the base of the caudal fin, and opposite the insertion of the ventrals. The undivided dorsal ray is osseous, strong in the adult and finely serrated posteriorly. There are $3\frac{1}{2}$ to 4 rows of scales between the lateral

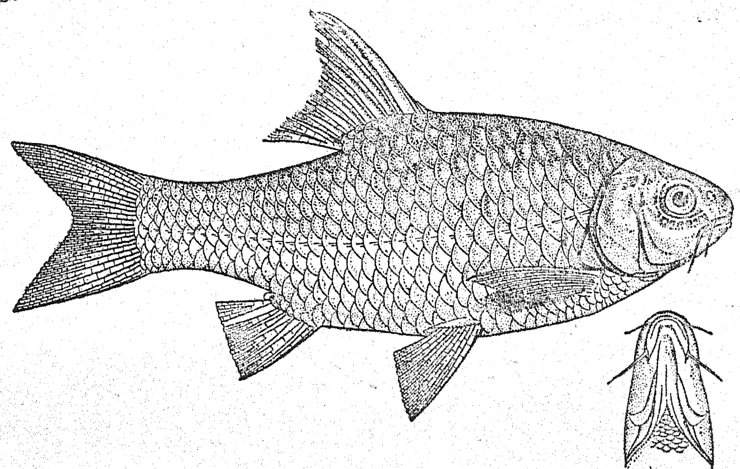


Fig. 33.—*Barbus* (*Puntius*) *sarana* (Hamilton).

line and the base of the ventral fin. *Colour*—silvery, darker above. Usually a golden blotch is found on the opercle and sometimes a small dark spot is also seen behind the gill-opening. The young individuals have a faint black spot covering 25th to 28th scales on the lateral line. The fins are greyish-white with the caudal, pelvic and anal fins tipped red.

6. **WHITE CARP. Barbus (Puntius) curmuca** (Ham.)

D. 12 (3/9); P. 16; V. 9; A. 8 (3/5); C. 18; L. 1. 41.

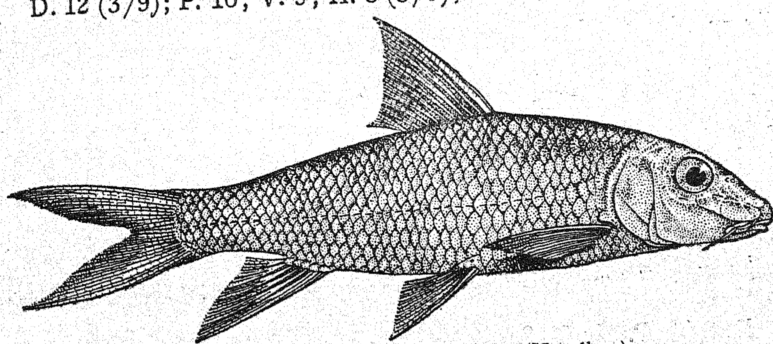


Fig. 34.—*Barbus* (*Puntius*) *curmuca* (Hamilton).

A fish attaining four feet in length, it is found along the Western Ghats of India. The dorsal profile is more convex than the ventral. The head is rather compressed with a conical snout and a

transversely concave interorbital space. In the adults, a band of open pores may be present running from the preorbital along the cheek. There are two pairs of maxillary barbels, the lower as long as the eye while the upper is only half as long. The dorsal fin arises in front of the ventrals and is rather nearer to the snout than to the base of the caudal fin; its last undivided ray is weak and articulated. The lateral line is complete, with $3\frac{1}{2}$ rows of scales between it and the base of the ventral fin. The caudal fin is deeply forked and its lobes are pointed. *Colour.*—The fish is silvery which is lighter on the sides and beneath. The tips of the caudal fin are blackish. In the young, however, the middle third of the caudal fin is orange and tipped with black.

7. **BLACK SPOT. Barbus (Puntius) filamentosus** (Cuv. & Val.).[1]

D. 11 (3/8); P. 15; V. 9; A. 7 (2/5); C. 19; L. 1. 21.

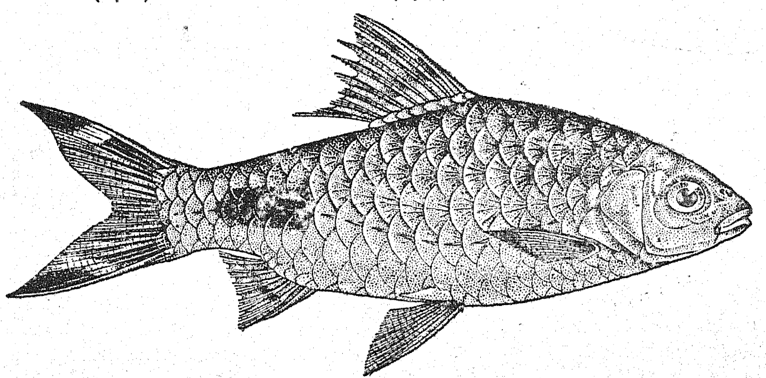


Fig. 35.—*Barbus (Puntius) filamentosus* (Cuv. & Val.).

This fish is only about 6 inches in length and it is found from Canara down the Western Coast, along the base of the Nilgiris to Travancore Hills and Ceylon. The body is compressed and the upper jaw is the longer of the two. The lower labial fold is interrupted. In the mature males the snout is covered with large pores. There is only one pair of small barbels which are difficult to make out at times. There is a thin maxillary pair extending to below the centre of the orbit in some specimens while it is very minute in others. The dorsal fin commences midway between the snout and the base of the caudal fin. Its last undivided ray is articulated, smooth and feeble. Some of the branched rays in the mature males are elongated. The caudal is deeply lobed. The lateral line is complete with $2\frac{1}{2}$ rows of scales between it and the base of the ventral fin. *Colour.*—The fish is silvery white, with a deep black oval mark on the lateral line covering the scales from about the fourteenth to the eighteenth. There is a dark band along the dorsal fin. The caudal fin is red, tipped with black.

It will be seen from the above description that this species shows marked sexual dimorphism. The form described as *Barbus mahecola*

[1] *B. mahecola* and *B. filamentosus* are males and females of the same species. See Hora, *Rec. Ind. Mus.*, XXXIX, p. 22 (1937) and Hora and Law, *Rec. Ind. Mus.*, XLIII, p. 245 (1941).

(Cuv. & Val.) is a female in which the tubercles are absent on the snout and the rays of the dorsal fin are not elongated beyond the membrane. Similar sexual dimorphism is found in *Barbus chagunio* described above.

8. **MALABAR CARP. Barbus (Tor) khudree** var. **malabaricus** Jerdon.

$$D. 12\text{–}13\left(\frac{3\text{–}4}{9}\right);\ P. 17;\ V. 9;\ A. 8\ (3/5);\ C. 19;\ L. 1. 24.$$

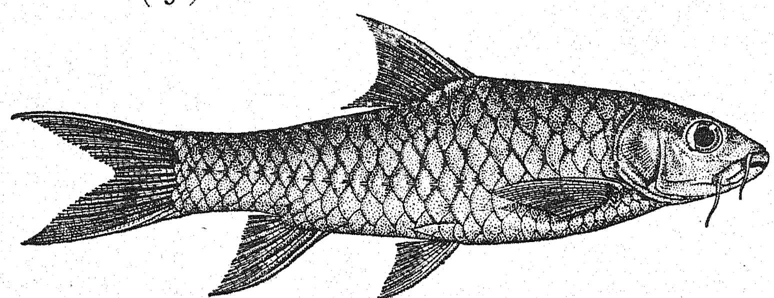


Fig. 36.—*Barbus (Tor) khudree* var. *malabaricus* Jerdon.

This fish is an inhabitant of the streams of South Canara, down the Western Ghats to the Travancore Hills. It attains at least 18 inches in length. The dorsal and ventral profiles are moderately convex. The upper jaw is slightly longer than the lower one. The lips are thick and the lower labial fold is complete and the lower lip is provided with a median lobe. There are two pairs of barbels of which the maxillary pair reaches to the hind margin of the orbit while the rostral pair is shorter. The dorsal fin arises in advance of the ventral and its last undivided ray is osseous, but weak. The lateral line is complete with $1\frac{1}{2}$ rows of scales between it and the base of the ventral fin. *Colour.*—The fish is bluish above, becoming white on the abdomen. The fins are usually blue and the eyes are red. Sometimes the fish is brown and the dorsal, pectoral and ventral fins are red, or against the edges of the fins may be dark.

This species is a race of the Deccan Mahseer or Khudree (*Barbus (Tor) khudree* Sykes) in which the dorsal fin has a weak and articulated spine.

Genus : **Labeo.**

9. **ROHU. Labeo rohita** (Ham).

Vernacular names :—*Ruhu*, Ooriah; *Ruee*, Ben.; *Nga-myit-chin* and *Nga-myit-tsan-nee*, Burmese; *Dum-bra*, Sind.

$$D. 15\text{-}6\left(\frac{3}{12\text{-}13}\right);\ P. 17;\ V. 9;\ A. 7\ (2/5);\ C. 19;$$
$$L. 1. 40\text{-}42.$$

This is the commonest carp of the plains. It is highly esteemed as food and is to be found in all sorts of water, the best being those taken in clear running water, and not too large. It is deep in form, the dorsal profile being more convex than the ventral. The greatest width of the head equals its length excluding the snout which is obtuse, depressed, but projecting beyond the

jaws. No lateral lobe is present. Lips thick, fringed with a distinct inner fold above and below. Generally there is a short and thin maxillary pair of barbels, though a rostral pair is sometimes present. The dorsal fin arises about midway between the snout and base of caudal fin. Pectoral is as long as the head excluding snout. Ventrals

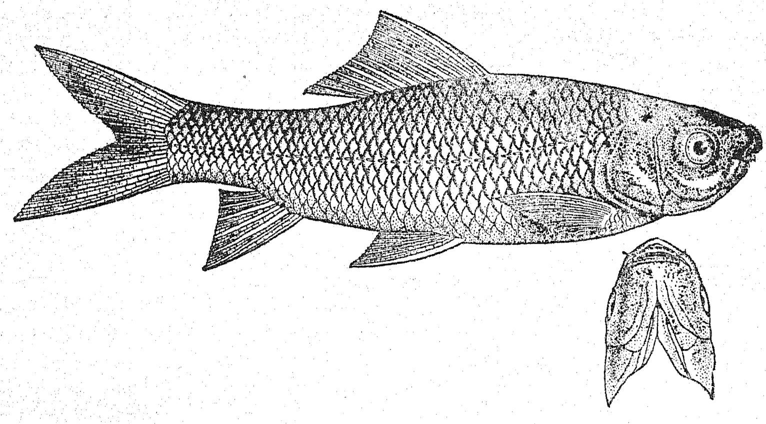


Fig. 37.—*Labeo rohita* (Hamilton).

are inserted below the third or fourth dorsal ray. Caudal is deeply forked. There are 6-6½ rows of scales between lateral line and base of ventral fin. The fish is bluish or brownish along the back, becoming silvery on the sides and beneath; sometimes there is a red mark on each scale. In some specimens the fins are black.

Rohu frequent the sluggish water of pools in rivers, and will occasionally be seen in shoals in slow runs sucking in vegetation off the top of the water. I have caught them while doing this in the Saber Matti near Ahmedabad in the following way:—On observing closely I noticed that green weed was the dainty morsel these fish were foraging. Some was collected and a fine cast with a very small hook provided the tackle; attaching the weed to the hook was a most tedious business. When this was done by wrapping it round the hook and tying it into position with fine silk the weed would come off as soon as it was in the water or swell too much to tempt the fish. Perseverance conquered. When the correct amount was gauged, a light float (quill) was attached to the cast 10 inches from the hook, and the bait allowed to move down with the current till it was engineered into the midst of a shoal where it was immediately taken, the float signalling the pop, pop movement of the fish sucking it in which was the indication to strike. I caught several fish this way, with the shoal still feeding.

The Rohu has a very small mouth set very low in the head, and almost below it. They are game fish, however, and when hooked will jump right out of the water two or three times. They provide one of the chief foods in Bengal and Bihar and are quite tasty. They do well in tanks where they are fished for in the commonly known way (seen chapter on 'Tank Angling').

Hand Line Fishing for Rohu.—I was shown by an old Mohamedan how to catch Rohu on a hand line, 'Tuggy' or 'Tungoos'

It is slow work but great fun when a fish is hooked. They seem to put up a much better fight in a river than in a tank. I detail this method so that anyone keen enough may give it a trial. I have caught fish up to 20 pounds in this way.

River Fishing for Rohu.—A line 60 yards in length is wrapped criss-cross over a small dried vegetable marrow. This is the substitute for the winch.

The Mount.—The mount is a thick piece of string $\frac{1}{8}$ inch thick, with a heavy weight 6 ozs or more fixed on to one end, and to the other end the line is attached. Equal distance from the ends are two fine pieces of line attached to the mount about 6 inches long, with a large hook attached (size 4/0 in Limerick hooks) to each length. Mount is about a yard long.

These are baited with nice juicy red earthworms, as much as they can hold, and then enough line is collected off the bobbin, and held in loops or laid in coils on the sand. The cast is then made by swinging the weight round in the manner of a stone sling, and cast into a slow flowing part of the river, which is either connecting two pools or is known to be a feeding ground.

The next operation is to collect in the line till it is as near taut as you can get it, without moving the weight, and to fix the line into a slotted bamboo peg which will give a slight resistance to a tug; this with the weight hooks the fish, and the funs begins. The peg is about 6 inches high.

Playing the Fish.—The line is picked up as soon as a run is registered, and the fish is played through the fingers, exactly the same way as we do on a rod and reel.

Clubbing the Fish.—When the fish is tired, and the mount comes into the hand, raise the head gradually to the surface. A small club which is held by the chin against the chest is used for knocking the fish on the head. The fisherman goes over his knees into the water to do this.

It is in this way with a lump of Raggi paste, the size of a duck's egg and no added weight that the big Mahseer and Rohu of the Cauvery and Cubbany rivers in Mysore are taken; and it was in this way, a correspondent informs me, that Rivett Carnac's 119-pound fish was captured. Substituting of course the rod and reel for the marrow!

Rohu Rising.—A Rohu comes to the surface and breaks the water with a loud splash and strong swirl, after which he generally lets up two bubbles. Bottom fishing for Rohu is dealt with fully in the chapter 'Tank Angling.'

10. **KALA BANSE. Labeo calbasu** (Ham.)

Vernacular names:—*Nalla-gandu-menu*, Telugu; *Kalbasu* and *Kunda*, Ben.; *Cuggera* (Siane); *Mahlee*, Assam; *Kala beines*, Ooriah and Hind.; *Di*, Punj.; *Di-hee*, Sind; *Dai*, Cutch; *Kurri-menu*, Canarese; *Nga-nek-pya*, *Nga-noo-than* and *Nga-ong-tong*, Burmese.

$$\text{D. } 16\text{-}18\left(\frac{3}{13\text{-}15}\right);\ \text{P. } 19;\ \text{V. } 9;\ \text{A. } 7\left(\frac{2}{5}\right);\ \text{C. } 19;$$

$$\text{L. } 1{\cdot}40\text{-}44.$$

The width of head equals its length excluding snout. Mouth narrow, obtuse and depressed. No lateral lobe but pores are present.

Lips thick, fringed, more especially the lower one, each having a distinct inner fold. There are four barbels, the rostrals being slightly the longer, equalling the diameter of the eyes. Dorsal fin arises midway between the snout and the base of the caudal fin. Ventrals commence below the fourth or fifth dorsal ray. Caudal is deeply forked. There are $5\frac{1}{2}$ to 6 rows of scales between the lateral line and the base of the ventral fin. The fish is blackish, sometimes with a scarlet centre for many of the scales. It grows to 3 feet in length.

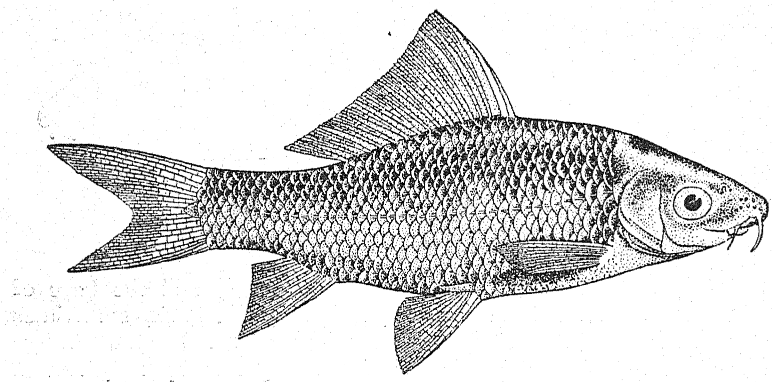


Fig. 38.—*Labeo calbasu* (Hamilton).

These fish seem to have a partiality for old masonry, walls and sunken trees in river and can be seen playing about in such places, sucking, and rubbing their sides against the masonry or trees, as the case may be. They are in structure the same as the Rohu, and are even known by some as the Black Rohu. This fish is well illustrated in Thomas' 'Rod in India'. I have taken them on small Fly Spoon, once or twice, but this is most unusual as the mouth of the fish is set right below the face and is very small. I was fishing for Mahseer at the time.

They rise unlike the Rohu in a most frightened manner, coming up to the surface with a rush, almost perpendicularly, and turning on the surface, go down as fast. They are game fish, and are best caught in the manner shown under 'Tank Angling'. They do well in tanks. The largest I have caught was 16 pounds.

Genus : **Cirrhina.**

11. **MIRGIL. Cirrhina mirgala** (Ham.)

Vernacular names :—*Mirrgah*, Ooriah; *Mirgala*, Beng. and Hind; *Naim*, Hind. (N.-W.P.); *Nga-kyin* and *Ngga-gyein*, Burmese; *Mor-ah-kee*, Sind and Cutch.

$$D.\ 15\text{-}16\left(\frac{3}{12\text{-}13}\right);\ P.\ 15;\ V.\ 9;\ A.\ 8;\ \left(\frac{3}{5}\right);\ C.\ 15;$$

$$L.\ l\ 40\text{-}45.$$

This is a fine fish of elegant appearance. The greatest width of the head equals its length behind the middle of the eyes. The eyes are situated in the anterior half of the head. Width of mouth equals 2/5 of the length of the head. Pores may or may not be present on

rather nearer to the snout than to the base of the caudal fin, and the snout. Only two barbels are present. The dorsal finarises rather nearer to the snout than to the base of the caudal fin, and opposite the 12 scale lateral line. Pectoral fin is as long as the head excluding the snout, and does not reach the ventral. Caudal fin

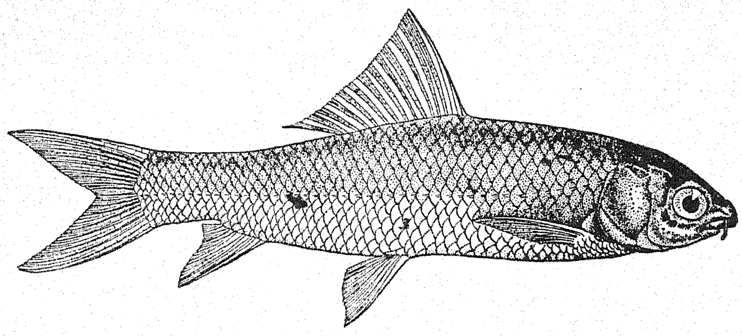


Fig. 39.—*Cirrhina mirgala* (Hamilton).

deeply forked $5\frac{1}{2}$ to 6 rows between lateral line and the base of ventral fin. *Colour.*—Silvery dark grey along the back, sometimes having a coppery tinge. The pectoral ventral and anal orange stained with black. Eyes golden. The fish grows up to 3 feet in length. (See also Chapter X.)

12. **CIRRHINA CIRRHOSA** (Bloch).

Vernacular names.—*Ven-candi*, Tam.; *Aruzu*, Telugu.

$$\text{D. } 17\text{-}19\left(\frac{3\text{-}4}{14\text{-}15}\right);\ \text{P. } 19;\ \text{A. } 8\left(\frac{3}{5}\right);\ \text{C. } 19;\ \text{L. l. } 42\text{-}44.$$

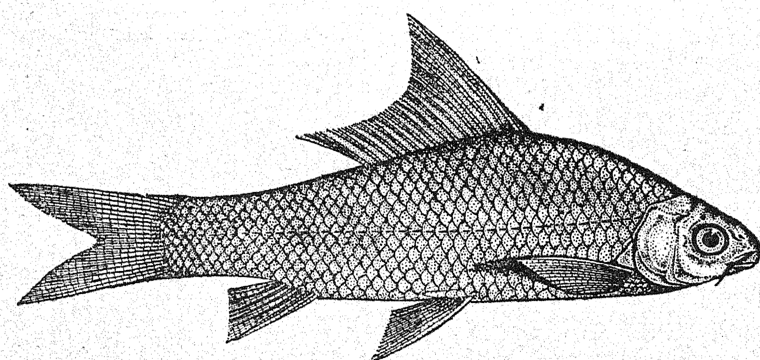


Fig. 40.—*Cirrhina cirrhosa* (Bloch).

The dorsal profile of this fish is more convex than the ventral one. The greatest width of head equals its length excluding snout. Width of mouth equals 1/3 of the length of head. Usually some fine pores are present on the snout. Four barbels are present of which the rostrals are rather longer. The dorsal fin arises considerably in advance of the ventrals and midway between the snout and the posterior position of the base of the anal fin. In some large

specimens the first few rays are very much elonged. Caudal deeply forked. There are $5\frac{1}{2}$ to 6 rows of scales present between the lateral line and the base of the ventral find. *Colour*.—Silvery, every scale having a red centre except along the abdomen where they are of dull yellowish white. Dorsal, caudal the outer end of the anal and pectoral stained with grey.

Mirgal or Naini are caught in the same manner as the Rohu, in river though they do not come up to the surface like the Rohu to suck in vegetation. The mouth of this fish is set higher in the head, though small and of the same warty construction as the Kala Banse. They do excellently in tanks and are quite game fish, caught in the same manner as the Rohu in tanks.

Genus : **Catla.**

13. **CATLA. Catla catla** (Ham.)

Vernacular names :—*Botchee*, Telugu ; *Catla*, Beng. and Hind., Punj. ; *Barkur*, Ooriah ; *Nga-thainv*, Burmese ; *Tambara*, Hind. (*Bombay*) ; *Boassa*, Hind. (N.-W.P.) ; *Tay-lee*, Sind.

D. 17-19 $\left(\frac{3\text{-}4}{14\text{-}16}\right)$; P. 21; V. 9; A. 8 $\left(\frac{3}{5}\right)$; C. 19; L. 1. 40-43.

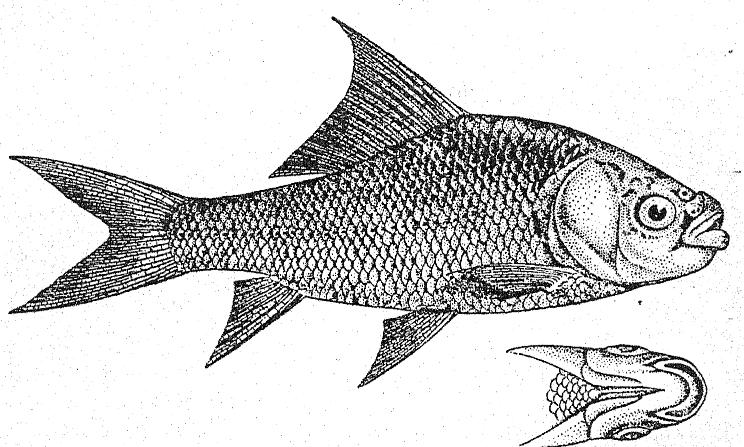


Fig. 41.—*Catla catla* (Hamilton).

This fish is largely employed for stocking tanks. It grows to about 6 feet in length. It is much esteemed as food when not exceeding two feet for the fish becomes coarser as it grows bigger.

The eyes with free orbital margins are situated in the anterior half of the head which is broad and the greatest width of which equals its length behind the middle of the eyes. The mouth is wide with a prominent lower jaw. In large specimens pores may be present on the snout. No upper lip, but the lower one is large and folded. No barbels present. Body is moderately compressed. Dorsal profile more convex than the abdominal one. The dorsal fin arises in advance of the ventrals. Pectoral extends to the ventrals which in males reach the anal. Anal laid flat, reaches to beyond the commencement of the caudal. There are $5\frac{1}{2}$ to $6\frac{1}{2}$ rows of scales

between the lateral line and the base of the ventral fin. The fish is greyish above becoming silvery on the sides and beneath. Fins are dark coloured, becoming nearly black in some specimens.

The diet of this fish is difficult to determine with any certainty, but it is occasionally taken in tanks when fishing for Rohu, and is essentially a sporting fish of the tanks alone. (See chapter under 'Tank Angling'.)

Catla rise much in the same fashion as Rohu, and have the same habit of sucking on the surface, where scum or green slime has collected. An expert with dry fly may capture them on a hook baited with the green weed mentioned under Rohu. They are game and good fighters.

Genus : **Barilius**

14. **INDIAN TROUT. Barilius (Opsarius) bola** (Ham.)

Vernacular names:—Hind. *Bola Goha*, and *Buggarah*. Beng. *Bola*; Punj. *Pahtah*; Behar *Chagunee*; Ooriah *Bugguah*; *Korang*, Assam.

D. 3/7-8; A. 3/10; P. 13; V. 9; C. 19; L. 1. 88-94.

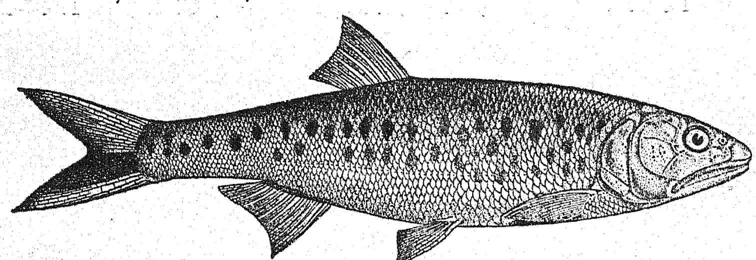


Fig. 42.—*Barilius* (*Opsarius*) *bola* Hamilton

This fish possesses the characteristic Trout-like form with the head and body greatly compressed, the head being sharply pointed. It is proportionately smaller in the younger individual. Its dorsal profile is scarcely arched while the ventral one is somewhat convex. The eye is situated entirely in the anterior half of the head and in adult specimens the mouth opening extends about $1\frac{1}{2}$ diameter of the eye behind the posterior margin of the orbit. The mouth is very wide and directed obliquely upwards. The upper jaw is the longer and is deeply notched in the middle to receive a prominent knob of the lower jaw. Barbels are absent and the scales are very small. The lateral line is carried anteriorly and then it is continued to the lower half of the caudal fin. The dorsal fin arises midway between the posterior margin of the orbit and the base of the caudal fin; it is behind the anterior origin of the ventrals. The pectoral fin is as long as the head behind the eye, and is separated from the ventrals by a considerable distance. There is a scaly appendage in the axil of the pectoral fin. The colouration is much lighter in young individuals than in the adult. The back is greenish grey.

The Indian Trout, or *Barilius bola*, as is better known, is really not a trout. He is game looking and quite good eating. He is common over all N. India and Burma, and large bags can be made with fly spoon or fly. I have had 40 fish in a couple of hours in the

Sahmaw Chaung and many over 2 pounds in weight. This fish is excellently illustrated in colour in the B.N.H. Society's Journal No. 2, Vol. XXXIX.

The maximum weight given in the 'Rod in India' is well exceeded by the fish in Burma, and I should call it 3 to 4 pounds. My best was 3 pounds and was in a very small stream (see notes on 'Sahmaw Chaung'). In large rivers he would grow proportionately in weight and dimensions.

Good Bait for Mahseer.—The small one are particularly beloved of the Mahseer, so make an excellent live or dead bait. They will occasionally jump out of the water when hooked, and seem to prefer slow moving water above a rapid with fairly large boulders, to the actual rapid itself. I have been most successful in smooth water. They are highly predacious fish, as the following amusing incident will prove.

While I was at Sahmaw in Burma, I had the forest officer staying with me. He was a keen fisherman. The stream was about 15 yards in front of my bungalow, and had a nice pool in front and in full view of the verandah. After tiffin 'George' as he was commonly called, made a cast and was taken by what appeared to be a good fish. The reel screamed, the rod bent in two and a furious fight went on for about 10 minutes. This was being watched by an interested company from my verandah, when suddenly the rod slacked and we thought he had lost his fish. He reeled in a small *B. bola* about 6 inches long which had obviously been taken by a large fish, and the fight was the disputed right of who should have the fish, George or the big fellow!! He suffered much leg pulling for taking 10 minutes to land a fish of a few ounces.

Tackle and fishing for this fish is the same as for small Mahseer, as mentioned in Chapter IV.

15. BARILIUS TILEO (Ham.)

Vernacular names:—*Tilei*, *Sel-len*, *Boolla* and *Sund-u-a-rie*, Assam.

D. 9 (2/7); P. 14; V. 9; A. 13 (3/10); C. 20; L. 1. 69-75.

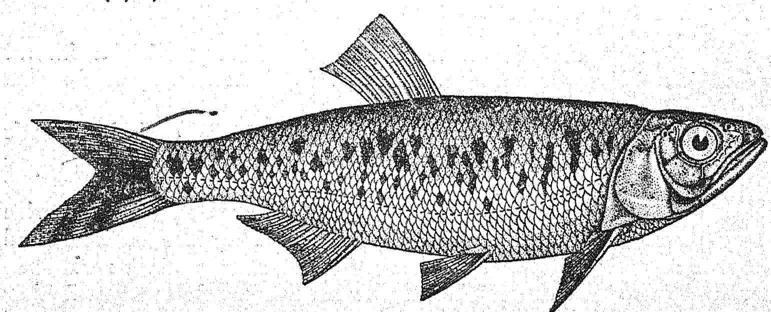


Fig. 43.—*Barilius tileo* Hamilton.

This is the only other fish likely to be confused with *B. bola*. It is similar in colour, but does not attain more than one and a half pounds in weight. It is distinguishable by its shape, being 'pot bellied' *i.e.* the abdominal profile more convex than the dorsal. The snout is pointed, and back almost straight giving the appearance of

the head being cocked up. It is taken in similar water to that of *Barilius bola* and in the same way. Fights well. *General.*—It is a good table fish but bony.

Genus : **Cheela.**

16. **CHILWA. Cheela argentea** Day.

Vernacular names :—*Chaya-vellachee* or *Vellachee-cundee* Tam.

D. 9-10 $\left(\frac{2\text{-}3}{7\text{-}8}\right)$; P. 15; V. 8; A. 17-19 $\left(\frac{3}{14\text{-}16}\right)$; C. 19; L. 1. 43-45.

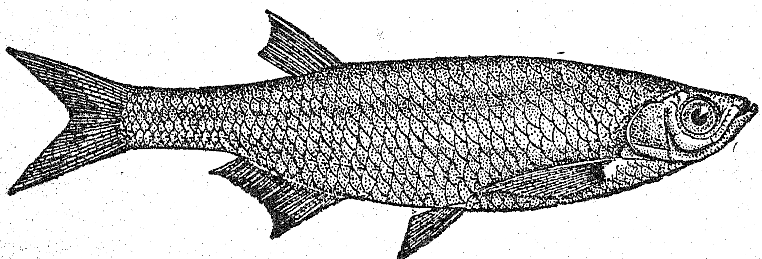


Fig. 44.—*Cheela argentea* Day.

This is a bright silvery fish, keeping mostly at the surface of the water. It has a long, more or less compressed body with a small head and upturned mouth. The cleft of mouth extends to below the anterior third of the orbit. There is a knob above the symphysis of the lower jaw. The sub-orbital ring of bones is very broad and nearly covers the cheek, the third almost touching the preopercular ridge. The breast is without a sharp edge. The dorsal fin is situated over the commencement of the anal fin, and is in the posterior, third of the distance between the snout and the base of the caudal fin. The pectoral fin reaches the ventral and the caudal is deeply forked. The lateral line descends gently for the first twelve scales, and finally attains the centre of the caudal. There are $1\frac{1}{2}$ rows of scales between the lateral line and the base of the ventral fin, and about 27 to 30 rows anterior to the dorsal fin. *Colour.*—Silvery with a lateral band which fades after death. Caudal is dark edged, as is also occasionally the anal.

A small, narrow, closely-scaled, very delicate fish. It is difficult to handle without the hands getting covered with scales. Some anglers (the lover of the fly) will spend hours with a tiny fly, amusing themselves catching these fish. I find it tame sport, for even with three fly on at a time they give little fun. They are so long and narrow that they seem unable to hold the water against resistance of even the lightest rod. They make excellent bait for any fishing where predatory fish are sought as they seem to be the most favoured of all the small fish. If the Chilwa are moving in the river it may be safely assumed that the larger fish are on the feed, and good sport imminent. Does equally well in tanks and rivers.

Order: **Siluroidea.** Sheat Fishes

These are the scaleless fish, popularly known as Cat-fishes in virtue of their feelers or long barbels which are arranged around the mouth. Though essentially a fresh water group, some species are also found in salt water, usually keeping, however, near the coast. Some of the members of this family grow to such a huge size that they are generally known as 'Fresh water sharks'. They mostly prefer muddy to clear water, a fact for which their feelers are well suited. The Sheat Fishes are easily distinguished, chiefly by the absence of scales and the presence of barbels or feelers and frequently a second dorsal fin which is known as the adipose fin. The mouth is always furnished with teeth, which, however, varies much in form and disposition. They all take a live bait picketed or a spinning dead bait; sometimes a spoon or phantom. They should all be fished for with wire and treble hooks. They do not give much play and are apt to sulk on the bottom.

Sheat-fish is derived from Schaid-fish, the former German name of *Silurus glanis*, the Wels of the Danube.

Genus: **Bagarius**

Gill openings wide, gill membranes confluent with the skin of the isthmus. Barbels eight, one pair nasal, one pair maxillary and two pairs mandibular. Palate edentulous, teeth in jaws pointed and unequal. Thorax destitute of any adhesive apparatus. Dorsal fin with one spine and six rays, adipose dorsal present. Dorsal, pectoral and caudal fins produced into long filaments.

17. **GOONCH, Bagarius bagarius** (Ham.).

Vernacular name:—*Bagh Ari*, Dinajpur and Rungpur; *Vaghair*, Purnah; *Boonch* or *Goonch*, N.-W. Provinces; *Gorea* or *Bag Machh*, Assam; *Rahti Jeyyah*, Telugu; *Sah-lun*, Ooriah; *Kheerd*, *Moolandah* and *Guwch*, Poona and environs.

D. 1/6/0; A. 12–15; P. 13; V. 6; C. 17.

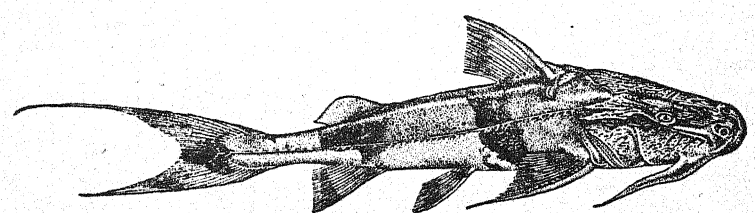


Fig. 45.—*Bagarius bagarius* (Ham.).

Head depressed and naked. Eyes small, situated in the middle of the posterior half of the head. Mouth ventral, considerably behind the tip of the snout. Teeth sharp and unequal in the jaws. An outer widely separated row of larger ones is also present in the mandibles. There are eight barbels, the nasals being smaller than the diameter of the eye, the maxillary barbels possess broad bases and are generally shorter than the head. The dorsal spine is smooth, and the fin has elongated soft termination of varying length. The pectoral spine is stronger, serrated internally and provided with a soft pro-

longation. The caudal fin is deeply forked and both the lobes are produced into soft filamentous processes. The caudal peduncle is narrow and whip-like. The skin on the body is scabrous. This is multicoloured fish, yellow, black, brown and blue. The colouration, however, will also depend on the type of water inhabited by a particular specimen. This fish grows to a size of six feet or more and to a weight of over 250 pounds.

These monsters are as ugly as they are unpopular, and are taken in the same water as the mahseer. They have a most remarkable power of adhesion, and when hooked can hold on to the bottom of the river whether it be sand or rock, and in the strongest of currents. They will waste hours of your time if in any numbers, and owing to sulking take twice as long to kill as a mahseer. Coarse eating and looking, and should be classed as the vermin of the water. Not found in tanks.

Genus : **Silonia**

Body elongated and compressed. Head moderate and rounded anteriorly. Eyes lateral, behind the angle of mouth and visible both from above and below, and provided with circular adipose lids. Mouth anterior, wide and obliquely directed upwards. Lower jaw somewhat longer and broadly pointed in the middle. Teeth in the jaws large and caniniform, projecting outside. A continuous V-shaped band of villiform teeth across the palate. Post-labial groove widely interrupted in the middle. Nostrils wide apart and slit-like. Two small maxillary barbels in grooves and hence liable to be overlooked. Dorsal provided with moderately developed bony spine which is roughened externally and serrated internally. A small adipose fin present. Pectoral spine also is strong and serrated internally. Gill membranes deeply notched united with each other but free from isthmus.

18. **SILUND, Silonia silondia** (Ham.).

Vernacular names :—*Silun* (Bengal for young and half grown). *Dhain*, Bengal for larger specimens; *Silondia-Vacha*, Calcutta; *Silon*, Dinajpur and Rungpur; *Baikar*, Gorakhpore; *Silond*, Punjab; *Ji-lung* and *Silond*, Ooriah and Beng.; *Wanjou*, Telugu.

D. 1/7/0; P. 1/11-13; V. 6; A. 4/36-44; C. 17.

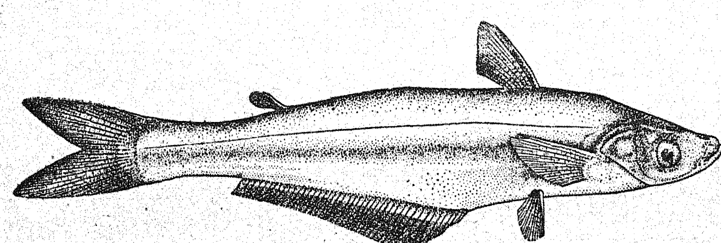


Fig. 46.—*Silonia silondia* (Hamilton).

In its younger stages this fish is herring-shaped, but with age its belly becomes very bulky with the result that in full-grown specimens the ventral profile is greatly arched.

Colouration.—According to Hamilton 'The back is of a dusky green'. The silund is the fresh water shark, and comes first in this group from the sporting point of view. They attain a length of 6 feet, and a weight up to 100 pounds. They have two small barbels, dorsal pectoral fins thorned. Anal fin rays 36-44. Caudal large and strong. Mouth, armed with rows of sharp formidable teeth, is large and square. The general appearance is that of a large Butchwa. They feed in shoals much the same way as Butchwa, and can be located by the heavy splash-splash when they are feeding. They are fished for the same way as the mahseer, only dead bait is more killing than spoon. They frequent the fast waters in the lower reaches of the rivers, swirls, behind piers and bridges, or where the water is broken. They can also be taken in still deep pools by trolling a dead bait slowly, or with live bait on the bottom. They are found in all the large rivers of N. India and Burma. Do not let its old scientific name *Gangetica* mislead you into believing that they are only to be had in this river system. The two fish in the photograph elsewhere in this book, were caught at Namti in N. Burma.

They go off with a rush the same as Mahseer, and will jump 4 or 5 feet out of the water when hooked. Excellent sport can be had with these fish at the head of a pool, when a river comes down in flood, generally at the beginning of the monsoon. A large bait, 6 inches long, is the best size and the most attractive. It is a worthy substitute for the Mahseer, if one is stationed in the plains away from the haunts of *Barbus tor*. Use only wire traces when fishing for the species. It is not a tank fish.

Genus : **Wallagonia**

Among the Siluridae, *Wallagonia* is characterized by the possession of a short dorsal fin of about five rays, by the deeply forked caudal fin which is free from the anal fin, by the free orbital margins to the eyes and by the position of the eyes above the level of the corners of the mouth.

19. MULLEY OR FRESH WATER SHARK. Wallagonia attu (Bloch. and Sch.).

Vernacular names :—*Boyali*, Bengal; *Boal* or *Pangash*, Ooriya; *Wah-lah*, *Vale* or *Vallah*, Tamil; *Gwali* or *Mullee*, Hind.; *Bawqli*, Assam; *Mul-la* and *Pi-i-hee* and *Jer-i-hee*, Sind; *Poikee*, Gond. Paren.

D. 5; P. 1/13–16; V. 8–10; A. 4/82–89; C. 17.

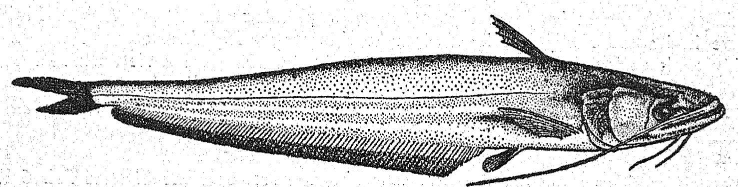


Fig. 47.—*Wallagonia attu* (Bloch).

This is the mulley or the so-called fresh water shark. It is devoid of scales and is provided with long feelers. It is not eaten by the

higher classes on account of its forbidding aspect and unclean feeding habits. It is a greatly elongated fish. The huge mouth is armed with two broad bands of large sharp teeth. The fish is a monster growing to 6 feet in length. The head is the most conspicuous part of the fish. The eyes are small, situated entirely above the mouth opening. The snout is spatulate and the lower jaw slightly the longer. The maxillary barbels extend to the anterior part of the anal fin, while the mandibulars are as long as the snout. Broad bands of depressible pointed teeth are found on the jaws; those of the posterior rows increasing in size. The vomerine teeth are similar and are situated in two oval patches. The lateral line is well marked. Colour uniform grey.

It is queer in shape, with an enormous head and mouth running down to a point, and in small tail. The head must weigh more than half of the total weight. The anal fin runs down almost the whole length of the body. Is blue in colour. His mouth, like the Silund's, is well armed with sharp rows of teeth, takes all forms of bait. Is not a very good fighter, is highly predacious, and fancied as a table fish.

Found in tanks and rivers, and are best taken in the evening when they feed along the edges in shallows, on frogs, and small fish. I have seen these fish taken in Bihar in a curious way, in the many large lakes. The fishermen use a stout cord, about 5 feet long, tied to a strong bamboo, 7 feet long. A large hook is mounted to the end of the cord on which as many earthworms as possible are attached. A boat is then quietly moved along the edge of the lake, and when a suitable spot is arrived at, the top of the rod is briskly worked backwards and forwards in the water, to disturb the surface. It is then allowed to rest for a while and the performance repeated, with the usual interval between; if no fish is taken, the boat is moved on and the same procedure followed. I have seen four and five large fish taken in this way in a morning. The fish is apparently attracted by the vibrations set up, and when he arrives finds a hook full of worms awaiting him. Do not stock them in tanks, or they will devour everything except themselves.

Mr. Dunsford gives a very interesting account in 'The Anglers' Hand Book', on how to catch this fish in tanks with fly rod, which I reproduce here, for those readers who would like to give it a trial.

'A good deal can be done with a spoon or phantom in a tank full of Mallis. I have had some really excellent sport in this way. My first attempt was in a muddy tank under the Fattehabad Bungalow in the Hissar District, where I took 125 fish, all Mallis in three days, with spoon and phantom.'

'This was in the month of June some eight years ago. On my next visit in the following February, I took about 15 fish in three days, on spoon only, but they ran much bigger, and the thinning out had evidently allowed them to grow. The average weight on the first occasion was about 2 lbs. and the biggest fish 6 lbs. while on the second occasion the average weight was 3 lbs. and the biggest 10 lbs. I have no doubt that if I had remained in the Hissar district, till the hot weather, I should have made a good bag of decent sized fish in this tank.'

'I have off and on done a good deal in this way, but the cream of this sport as far as my own personal experience goes, was obtained on the 31st May and

1st June 1888, just a fortnight before writing these notes, when I tried a couple of tanks at Kharkhoda, in the Rotak district.'

'On the 3rd May I killed 32 "Mulleys" weighing 115 lbs., of which 11 weighing 40 lbs. were taken on live bait, and 21 weighing 75 lbs. on a $1\frac{1}{2}$ inch spoon (silver). The biggest fish on this day weighed 12 lbs.

'After this they got to know something about the spoon, and more so as, owing to blunt hooks, several fish were severely pricked and got off. On the 1st June I killed 10 fish, weighing 37 lbs., and on 2nd June 11 fish, weighing $33\frac{1}{2}$ lbs. Total bag for three days 53 "Mulleys" weighing $185\frac{1}{2}$ lbs., average weight exactly $3\frac{1}{2}$ lbs.'

There are, besides, many other ways of catching this fish. Frog on the surface or on the bottom, dead or live bait, meat or even *atta*, if it is highly flavoured.

Any tank that takes in flood water, during the monsoon, or pools in the beds of rivers, etc., will almost certainly hold these fish in large numbers.

Genus : **Mystus**

20. **TENGRA**. **Mystus seenghala** (Sykes).

Vernacular name :—*Teng-ga-ra*, Punj.

$$D. 1/7;\ P. 1/9;\ V. 6;\ A. 11\text{-}12\left(\frac{3}{8\text{-}9}\right);\ C. 19\text{-}21.$$

The fish attains a big size. The greatest width of its head equals $\frac{1}{2}$ to 4/9 of its length. The upper surface of the head is granulated in ridges and its median longitudinal groove reaches the base of the occipital process. The snout is spatulate and the upper jaw is the longer. There are four pairs of barbels. The maxillary extends to the middle or just beyond the hind margin of the dorsal fin, the nasal to opposite the middle of the orbit, the external mandibular to the base of the pectoral fin and the internal is one-third shorter. Teeth are present on the palate in an uninterrupted crescentic band. The spine of the dorsal fin is weak and indistinctly serrated posterior-

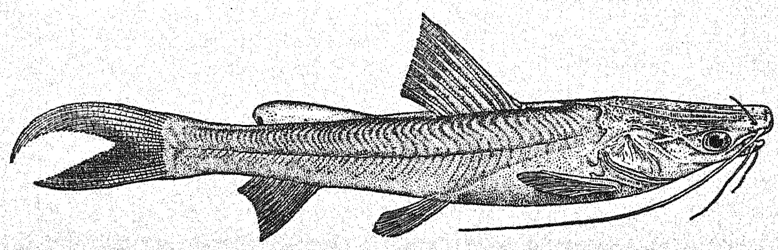


Fig. 48.—*Mystus seenghala* (Sykes).

ly. It is as long as the head excluding the snout. The spine of the pectoral fin is stronger, roughened externally, denticulated internally and is half as long as the head. Ventral fin arises behind the vertical

from the last dorsal ray. The caudal fin is deeply forked, upper lobe being the longer. There is a large, pear-shaped air-bladder which is not enclosed in bone. *Colouration.*—The fish is brownish along the back and silvery on the sides and beneath with a round black spot at the posterior end of the base of the adipose dorsal fin. It is quite a game fish and taken chiefly on baits of the ranker nature; entrails, bad meat, dead fish, and near burning ghats, though he may occasionally be had on spinning baits. It is fancied as a table fish. Day gives—'The Indus, salt-ranges of the Punjab, Jumna and Ganges certainly as low as Delhi, also the Deccan, Kistna river to its termination, and Assam.'

Genus : **Eutropiichthys**

21. **BUTCHWA. Eutropiichthys vacha** (Ham.)

Vernacular names :—*Butchwa*, Hind. ; *Vacha*, Beng. ; *Butchwa* and *Nandi butchwa*, Ooriya; *Bikree*, Oudh, Punj. ; *nee-much*, N.-W.F.P. ; *Chel-lee*, Sind ; *Nakhellettee*, Tamil; *Nga-myen-kouham* and *Katha-baung*, Burmese.

D. 1/7/0; P. 1/13-16; V. 6; A. 3-4/42-47; C. 17.

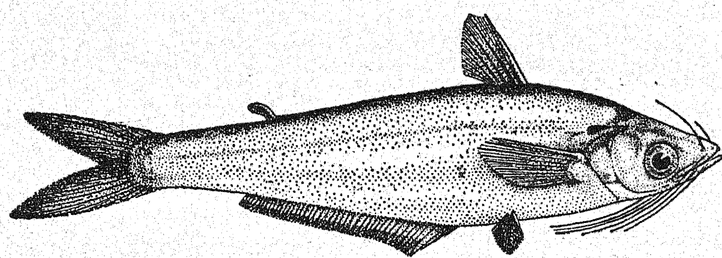


Fig. 49.—*Eutropiichthys vacha* (Hamilton).

The true Butchwa *E. vacha*, that is the game little fellow that takes a fly, fly spoon or any spinning bait and that hunts in shoals, has been confused by Thomas, Lacy and Skene Dhu in past works, with *Clupisoma garua*. In order to elucidate this, a short description and figures of the three common fish (all called Butchwa) will be of assistance. *E. vacha* (Ham.) (fig. 21) is the true form and the best known to anglers, taking fly and fly spoon readily, and if well on the feed disturb the surface of the water with the familiar splash-splash while taking toll of the small fish. They are usually found feeding near bridges, in runs, and in the swirls near masonry structure and at junctions.

It is easily distinguishable, with 4 pairs of barbels, and a well defined mouth extending back as far as the eye, with the dorsal and pelvic fins practically opposite, and the small adipose dorsal fin which is always present. The body is deeper and more stream lined than either *Clupisoma garua* (fig. 23) or *E. murius* (fig. 22). It is found both in the plains and far up the large rivers well into the hills. I have caught them up to $5\frac{1}{2}$ pounds in weight.

22. **Eutropiichthys murius** (Ham.).

D. 1/7/0; P. 1/11 (1/10 Day); V. 6; A. 3/35-40; C. 17.

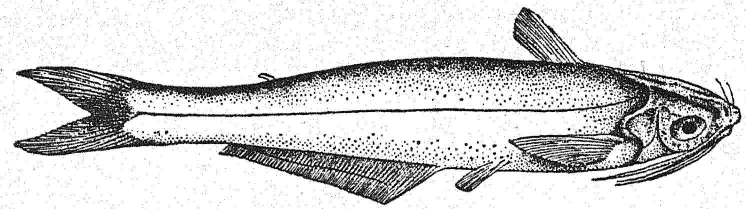


Fig. 50.—*Eutropiichthys murius* (Hamilton).

E. murius (Ham.) is in form much the same as *C. garua.* The main differences being, the head is smaller with the 4 pairs of barbels only extending as far as the head. The lips are fleshy as compared to the other two forms. Feeds on the bottom chiefly, and is taken at the mouth of sewage drains or under *Ficus* trees if the fruit is ripe and falling into the river. Will accept any rank bait.

23. **Clupisoma garua** (Ham.).

The back is not so arched as in *E. vacha*, the mouth is smaller with one of the 4 pairs of barbels (maxillar) extending to the pelvic fin. The dorsal is well in advance of the pelvic fin and there is no

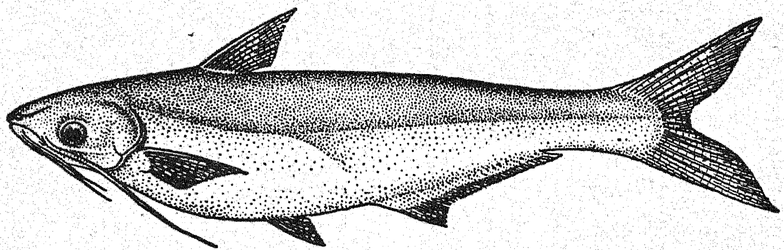


Fig. 51.—*Clupisoma garua* (Ham.).

adipose dorsal fin. This fish is seldom taken on fly or fly spoon, but while fishing well below the surface with worm and other rank bait.

E. murius and *C. garua* do not grow to more than 2 pounds, and are mostly found in the rivers in the plains, they do not appear to move high up the rivers as is the case with *E. vacha.* The fish vendor will sell them all as Butchwa, and though good table fish, because of their filthy feeding habits *C. garua* is to be avoided.

These fish are taken with light tackle used on the small mahseer and *B. bola.* They feed in shoals, and the water literally boils over when they are really on the feed, and small fish suffer complete deletion. Big bags can be made at times. They take best in the rains, and a good bait is the mole-cricket. I have taken 17 of these fish, in less than an hour, at the confluence of the Mali and N'Mai Khas,

north Myitkyina, where they run large. Here again I see Skene Dhu put the limit as 5 lbs., my best as I have said before was 5½ pounds, and a dozen fish worked out at an average of 3 pounds so that he seems to run larger in Burma. They are found in all stages in the course of the river, from the sluggish water of the plains to the rocks and rapids of the hills. They live in tanks but are destructive.

Family: NOTOPTERIDAE.

Genus : **Notopterus**

24. **SEETUL, Notopterus chitala** (Ham).

Vernacular names :—*Chitala*, Beng. ; *Chitu*, Oriya ; *Sital*, Assam ; *Gandan*, Sind ; *Mohie*, Bihari ; *Nesh* or *Mohi*, Punj. ; *Bunnih*, Tirhut.

D. 9-10 ; V. 5-6 ; A. 110-125 ; C. 10.

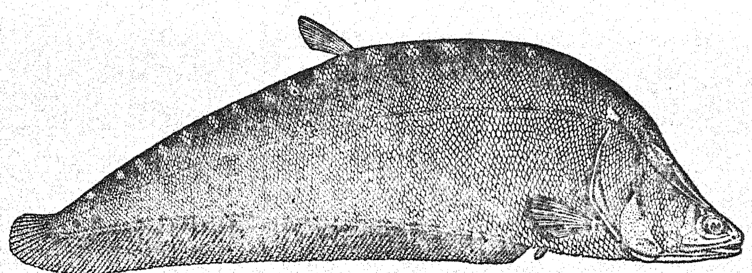


Fig. 52.—*Notophterus chitala* (Hamilton).

The fish is laterally compressed and in shape is more or less similar to *N. notopterus* but the back is more strongly humped in front and the ventral profile is almost straight. The upper profile of the head is deeply concave. The snout is rather prominent and the maxilla extends beyond the hind margin of the orbit. The pre-orbital is entire. Villiform teeth are present in both jaws, with an external enlarged row, most developed in the centre of the jaw. There are villiform teeth on the vomer and palate. The ventral fins are very minute and the anal and caudal are confluent. The scales are cycloid, extending over the body, opercles and some of the fins: those on the head are not much larger than those on the body. There are about 51 serrations along the abdominal edge between the throat and the insertion of the ventral fin. Colour, silver dark along the back, with about 15 transverse silvery bars on each side of the dorsal ridge, some meeting the corresponding marks on the other side of the ridge. There are about 7 or 8 black spots near the end of the tail. Dorsal fin is yellowish grey white, the other fins are almost white, washed with silver on the basal half. This fish grows to about 4 feet in length.

The Seetul. Thomas in 'The Rod in India' writes:—

'Previously knowing them only by book and report, I first saw them for myself at the Narora anicut. The water was alive with them, rolling over on the surface, displaying their bright silvery sides; they are very flat-sided as well as silvery, and giving one the impression that they were surface feeders. On that hypothesis therefore I fished for them, and fished in vain. But there were some seven other rods there beside your humble servant, rods to whom the Seetul was no stranger, and one of them catching one I asked to see it. The formation of the mouth made me mistrust the surface antics as play, not feeding, and conclude that feeding would ordinarily be at the bottom. The size also of the mouth told its own tale. The mouth was remarkably small for so large a fish, indicating that the natural food must be small. And the dentition was not formidable, the teeth being viliform or file-like. I took a look also at the tackle with which my brother angler had caught the fish. But instead of exactly copying it, I had an idea I could manufacture something more to the fancy of my new customer.'

Although Thomas had success while the small fish were running, this by no means is the normal condition under which this fish is found. In most large tanks, one sees them turning lazily over at intervals of a few minutes, and in very local areas; so much does he appear to rise in one place, that the Indian fishermen tribes firmly believe that they live on mud, and dig holes in the tank over which they constantly rise. They will take bait on the bottom, and near the surface. I have caught them by both methods, and on both red worms, dead shrimps, and prawns; but they will also take a small live bait.

I will give here an interesting incident I witnessed in a railway water tank, which was about 30 yds. wide and 100 yds. long, and full of *Seetul*, or *Mohie* as it was locally called. A grey haired Muhammedan gentleman was catching these fish in a novel way. He baited his hook with dead shrimps, and had his float fixed about two feet above the bait. Just below the float was attached some cotton thread, which was wrapped on a kite flying bamboo reel, known in the vernacular as 'Latai'. His little boy was then sent across the other side of the tank, paying out thread from the 'Latai', and with this thread the child manipulated the bait over where a fish was seen to be rising. I saw the old gentleman take four fish in this way, and lose two. One fought like a tiger and weighed 18 lbs.

As soon as the fish was struck, the cotton thread was pulled away by a sharp tug, which released the knot on the line. This old gentleman taught me what I know of circumventing this fish; and it was he who told me that he had caught them on red worm and small fish, but his choice was for prawns and shrimps.

I have taken them with worm lowered down to the bottom when seen rising close to the bank, and by the method described above, but it must not be imagined that you have only to follow out these methods to catch them. Often will a fish rise 6 or 7 times right up against your float and not look at the bait; if this happens then move on to the next rise and try another fish, and so on.

The mouth of the fish is large enough to take a large bait, and some persevering anglers may take them spinning, though I must confess I have never given the time to further study this fish. I

have taken 7 fish in an afternoon, by the thread line method. They fight hard for a bit. They are useless for the table, being very bony and tasteless.

25. **Notopterus notopterus** (Pallas).

Vernacular names :—*Moh*, *But* and *Purri*, Punj. ; *Moh*, N.-W.P. ; ***Pholœ***, Beng. ; *Ambutan-Wallah* or *Babersknife* and *Chotta Wahla*, Tam. ; ***Wallah-tattah***, Mysore ; ***Pulli*** or '*a slice*', Ooriah ; *Kan-doo-lee*, Assam ; *Nga-hpeh* and ***Nga-phe***, Burmese.

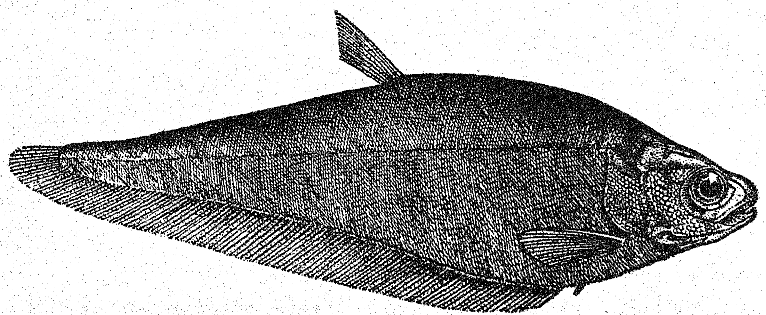


Fig. 53.—*Notopterus notopterus* (Pallas).

Family: SCOMBRESOCIADAE.

Genus: **Xenentodon**

26. **GARFISH. Xenentodon cancila** (Ham.).

Vernacular names :—Hindi, *Unt* ; Punj., *Kanga* ; Mahratti, ***Katra*** ; Ooriya, *Gongiturni* ; Burmese, *Nga-Phon-yo* ; Tamil, *Pissu-Kolah* ; Assam, ***Kokola***.

$$\text{D. } 15\text{–}18\left(\frac{2\text{–}3}{13\text{–}15}\right);\ \text{P. } 11\ ;\ \text{V. } 6\ ;\ \text{A. } 16\text{–}18\left(\frac{2\text{–}3}{14\text{–}16}\right);\ \text{C. } 15.$$

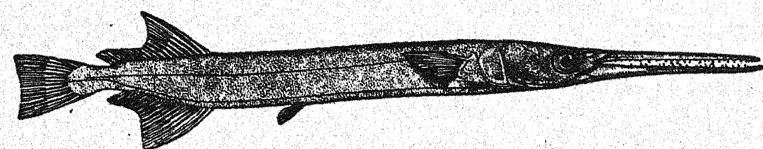


Fig. 54.—*Xenentodon cancila* (Ham.).

This fish inhabits fresh water of Sind, India, Ceylon and also Burma, and it attains at least 12 inches in length.

There is a deep longitudinal groove along the upper surface of the head and the lower jaw is the longer. There is a row of large, sharp, widely separated teeth in both jaws with an external row of numerous fine ones, there being none on the vomer. The dorsal fin commences opposite the anal fin. It is about twice as far from the anterior extremity of the orbit as it is from the posterior extremity of the tail. The ventral fins are inserted rather nearer the base of

the caudal than the hind edge of the eye. The caudal fin is slightly emarginate. The scales are small and are arranged in irregular rows on the body. *Colour.*—It is greenish-grey above, becoming white along the abdomen. There is a silver streak with a dark margin extending along the body from opposite the orbit to the base of the caudal fin. The upper two-thirds of the body is closely marked with fine black spots while there are from 4 to 5 layer blotches along the sides between the pectoral and anal fins though there may not be present in the juvenile ones. The dorsal and caudal fins are posteriorly tipped darker. The anal is whitish with a greyish margin. The eyes are golden.

Family: MURAENIDAE.

27. **EEL. Anguilla bengalensis** Gray.

Vernacular names:—Hindi *Kalan*; Mahratti *Ahir*; Tamil *Velangu*; Beng. *Bammachh*; Telegu *Dondupaum*; Chittagong *Balais*; Arracan *Ngami-toung;* Burmese *Nga-shin*; Andaman *Jitada.*

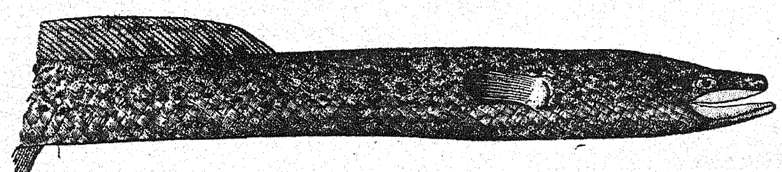


Fig. 55.—*Anguilla bengalensis* Gray.

A true eel attaining very great length, it is distributed in the islands in the Indian Ocean, Continent of India and Burma, being quite common at the Andamans. It is a snake-like fish and an irritable creature, swelling its head whenever angered. The head is broader than the body with a prominent lower jaw. The length of the cleft of mouth equals about 1/3 of that of the head and it extends behind the posterior margin of the orbit. The lips are well developed. The mandibular teeth are divided by a longitudinal groove while the vomerine band does not extend posteriorly so far as the maxillary one. The dorsal fin arises at a point, slightly more than the head length from the gill opening. The distance between the origin of the dorsal and anal fins is equal to the length of the head. *Colour.*—The fish is brownish above, becoming yellowish on the sides and beneath. Sometimes, the upper surface of the body is covered with black spots and blotches some of which may be continued on to the dorsal fin. The anal fin has a dark marginal band and a light outer edge.

Order: **Acanthoptergii**

Family: RYNCOBDELLIDAE. Thorny Eels.

Genus: **Mastacembelus**

28. **THORNY EEL. Mastacembelus armatus** (Lacépède).

Vernacular names:—*Bahm, Vahm,* and *Gro age,* Punj. and Sind; Kul-aral and *Sha-ta-rah,* Tam.; *Mudi-bom-mi-day* or '*Old Rhyncho-bdella*', Tel.; *Bahm,*

Bummmi and *Gonti*, Ooriah and Beng.; *Nga-naway-doh-nga* Burm.; 'Thorny-backed Eel'.

D. 32-39/74-90; P. 23; A. 3/75-88.

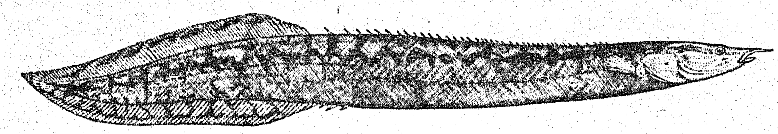


Fig. 56.—*Mastacembelus armatus* (Lacépède).

This is the spiny eel and is considered as nice eating. It is distributed throughout the fresh and brackish waters of the plains and hills of India, Ceylon and Burma to China. It attains two feet or more in length. The width of the body is 2/3 of its height in the young while in the adult it equals the height. The snout is trilobed at its anterior extremity. The maxilla reaches to below the front margin of the orbit. There is a preorbital spine and the angle of the preopercle possesses two or three strong denticulations. The dorsal spines commence over the middle of the pectoral fin. The vertical fins are confluent. There are about thirty rows of scales between the lateral line and the base of the first dorsal ray. *Colour.*—The fish is rich brown above, becoming lighter on the abdomen. A blackish band is sometimes met with through the eye and continued back in an undulating course along the upper half of the side. Above the band, a row of black spots are sometimes seen along the base of the soft dorsal fin. The pectoral fins are usually spotted while the dorsal and anal fins have bands or spots.

Family: OPHICEPHALIDAE.

Genus: **Ophicephalus**

The group of Murrals (*Ophicephalus*) are popularly known as Snake-headed fishes. In virtue of their accessory respiratory organ they can live in any kind of foul water. The body is subcylindrical, tapering from the flattened snake-like head to the rounded caudal fin. Large and irregularly shaped scales are present on the head. Lower jaw is longer: the maxilla reaching below the hind edge of the eye or sometimes even behind it. The teeth of the inner row of the lower jaw are conical while those of the palates are cordiform. The dorsal fin is continuous, arising above the pectoral which does not quite reach the anal. The head and body are covered with scales. There are about 18 to 20 rows of scales between the snout and the origin of the dorsal fin: nine rows between the eye and the angle of the preopercle. The number of rows between the lateral line and the dorsal fin is subject to variation. The fish is dark greyish above becoming dirty white beneath, cheeks and lower surface of the mouth streaked and spotted with grey; bands of grey or black are seen from the sides to the abdomen. It is able to survive out of water for a considerable time. Excellent table fish, and one of the favourites with the natives. It might be claimed that in any tank or stream where weeds prevail, this

fish will be found; even though the tank dries up they still survive, aestivating through this period. They can be seen at the surface of the water basking in the sun in the middle of the day, when they can be shot, though this is not sporting.

Parental care.—The Murral exhibits a keen parental affection towards the young, and can be seen working along the edge with a cloud of black youngsters over it. It furiously attacks any fish which comes near, and can be taken by a bait with ease though it is a shame to do so.

Beware of stocking tanks with this fish, where there are other varieties. They have no principles, and will even eat their young after they have attained a reasonable size.

Tackle.—Light tackle or stout gut, or fine wire for preference, as the teeth soon fray the gut; fished for in the manner for Pike, though he can be taken by better means if the opportunity comes your way.

In the C.P. and Berar, I have taken the fish in the two following ways :—

These fish abound in great numbers in the large tanks or lakes built as rain water reservoirs. There is generally a fringe of weeds running along the edge of the tank to about 8 to 10 feet. These fish can be seen on occasions, in the evening, feeding in shoals along the outside fringe of weeds. They move in one direction, and are located by a continual bob, bob, of black snake-like heads on the surface. A light rod and cast, with a fair sized hook run through a mole cricket, and cast into the shoal gives excellent sport, and 5 and 6 fish can be taken in this way out of a shoal, by following them up.

It is great fun and I have seen 11 fish taken in one evening. The fish run to 7 and 9 pounds each. I was indebted to an Uncle for this tip. The other method also tried out in the C.P. is baiting in the clearing of the weeds on the edge of the tank, where Chilwa collect. A live bait is fixed lightly through the back and lowered to a depth of three feet below the surface. The Chilwa are collected, and the Murral is signalled by a thousand small fish jumping out all round the float, like a fire-work display. The next moment the float goes and you have your fish.

Ophicephalus amphibius. McClell.

Ophicephalus amphibius, McClelland, Cal. Jour. Nat. His., V, p. 275. Plates 1 and 6.

Note.—McClelland's *O. amphibius* is united with *O. barca* by Day under the latter name. The species here described does not agree with Day's description of *O. barca* but seems to agree, except in colour, with the scanty notes of McClelland's *O. amphibius* given in Day's 'Fishes of India'. Dr. Hora is inclined to agree with Day in uniting the two species but, seeing that our specimens are all from the type locality of McClelland's *O. amphibius* and local names and habits agree, while the colours agree better with *O. amphibius* than with *O. barca* as described by Day, we have ventured to use McClelland's name.

Vernacular names :—*Bora Cheng*, Mechi; *Borna*, Rabha.

D. 51; P. 17; V. 1/5; A. 34; C. 14; L. I. 78. Barbels 2-retractile.

In shape almost identical with *O. marulius.* A pair of short, retractile, rostral barbels which are absent in the latter species. *Colour.*—A gorgeously coloured fish. The ground-colour is blue

when viewed obliquely and iridescent green when viewed at right angles to the surface. On the body this colour is sprinkled with dark spots, uniform in size but irregular in shape. These spots are absent from the belly, sparse below the lateral line and increasingly plentiful towards the back where they coalesce. On the head the spots are larger and rounded, rich brown below the level of the eye and becoming darker and more plentiful towards the top of the head where they coalesce. The brightest blue (green) and richest brown are in the region of the upper lip. Along the body 13-16 more or less irregular vertical bands about equal in width to the interspaces between them and extending from the dorsal to below to lateral line. These are bright orange bordered with brown and merging into brown on the back and are free from dark spots. The dorsal has the basal half brown or orange, the outer half blue (green), darkening outwards but having a narrow pale blue or white edge. Pectoral deep orange. Pelvics blue. Anal iridescent blue (green) with a narrow dark border. Caudal brown at the base, then iridescent blue (green) with dark rays, then blackish with a narrow white or bluish-white border. *Size.*—Our longest was 18.4 inches. *Habitat.*—Russell obtained his specimens in the vicinity of the Chel River about 1845 and gave them to McClelland. Our specimens all come from this vicinity but Dent, who obtained these specimens, has subsequently received reports from Rabhas living immediately east of the Torsa which indicate that the species is found there also. *Habits.*—The young are found, during the rains, in flooded paddy-fields enclosed by forest. The villagers catch them and put them in their wells to grow. Large fish are found in water-pockets in the beds of dried-up streams in the forest. Russell records that they are found in holes as much as two miles from the river.

Ophicephalus gachua (Ham.).

Vernacular names :—*Cheng*, Bengali; *Hill*, Nepalese; *Naserainiselo*, Mechi; *Na-ram*, Rabha; *Chaingo*, Hindi (Bihar).

D. 32-37; P. 15; A. 21-23; C. 12; L. I. 40-45.

Shape similar to that of *O. marulius*, but head scales larger. *Colour.*—Brown with a series of about eight darker brown bands sloping slightly forward from the vertical between the dorsal ridge and lateral line, sometimes produced below the latter. Pectoral fin with three lighter zones alternating with darker. Day gives—'In the young there is often a large ocellus with a light edge on the last five dorsal rays'. We have never found this present. *Size.*—We have had them up to about 8 inches. Day gives—'grows to at least 13 inches'. *Habitat.*—Muddy or clear streams and ponds from 2,000 feet downwards. Day gives—'Fresh waters throughout India, Ceylon, Burma and the Andamans, also near Gwadar on the Mekran Coast.'

Ophicephalus punctatus Bloch.

Vernacular names :—*Taki*, Bengali (local); *Lata* (Lower Bengali); *Na-taki*, Rabha.

D. 29-32; P. 17; A. 21-23; C. 12. L. I. 37-40.

Shape very similar to that of *O. marulius*. *Colour.*—Brown on the back fading to lighter beneath. A series of about eight vertical

darker bands above the lateral line alternating with a similar series below it. The last band before the caudal is continuous above and below the lateral line. Pectorals not spotted or striated. *Size.*—We have had them up to 7 inches long. Day gives—'up to a foot'. *Habitat.*—Streams in the hills up to 2,000 feet, muddy streams and tanks in the Terai and Duars. Day gives—'Fresh waters generally in the plains of India, stagnant preferred to running.' *Habits.*—Day, quoting Gunther in Ceylon, records that a female was taken in February containing 4,700 larger, besides some smaller, ova.

Ophicephalus stewartii Playfair.

Vernacular names :—*Dudu-cheng*, or *Te-cheng*, Bengali; *Na-ram*, Rabha.

D. 39-40 ; P. 17; V. 6; A. 27 ; C. 14. L. I. 45-50.

Shape similar to *O. marulius*, but the scales on the head are much larger. *Colour.*—Dark brown on the back fading to lighter on sides and belly. A series of about eight indistinct darker bands sloping forwards are generally visible above the lateral line and for a short distance below it. Some scales have a well-defined, circular, black spot. These spots are more plentiful above the lateral line where they roughly follow the darker bands. Below the lateral line they are fewer and more regularly arranged. The dorsal has a deep blue iridescence along its base, during life, and is white or white and orange along its outer edge. The chin is marbled and the pectorals spotted in zones. *Size.*—We have found them up to 18 inches. Day gives—'growing to about 10 inches. *Habitat.*—Clear streams in the forests of the Duars. Day gives—'Cachar and Assam, in both running and standing water'.

29. **MURRAL. Ophicephalus striatus** Bloch.

Vernacular names :—Hindi, *Moral, Sowl*; Punj., *Sowl*; Beng., *Sol*; Ooriah, *Sola*; Mahrati, *Sohr*; Canarese, *Marl*; Tamil, *Viral*; Tel., *Sowara*; Malabar, *Wrahl*; Assam, *Hal*; Chittagong, *Holi*; Coorg, *Owlu minu*; Singalese, *Lulla*; Burmese, *Nga-yan*; Mugh., *Nga-ain*.

D. 37-45 ; P. 17; V. 6; A. 23-26; C. 13; L. 1.50-57.

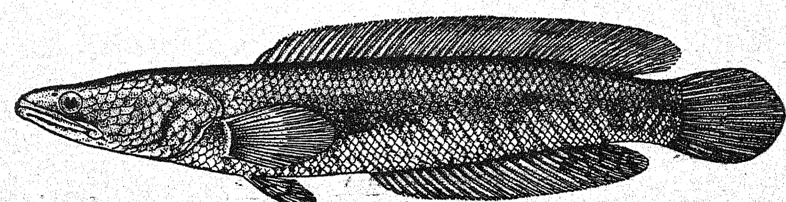


Fig. 57.—*Ophiocephalus striatus* Bloch.

In shape this fish resembles *O. marulius*. *Colour.*—Very dark brown above the lateral line, this colour continuing below this line in irregularly-shaped streaks, roughly parallel and a little off the vertical (the upper end in advance of the lower). The rest of the lower half yellow or orange. The pectoral not spotted or striated. The young

are orange-red, when 2 or 3 inches long. *Size.*—Our longest just over 2 feet. Day gives—'three feet or more'. *Habitat.*—Muddy rivers and tanks in the Terai and Duars. Day gives— 'Fresh waters throughout the plains of India, Ceylon, Burma, China and the Philippines, especially delighting in swamps and grassy tanks'. *Habits.*—Dent says—'The young, 2 or 3 inches long, are orange-red in colour. On a flooded paddy-field, where the water is 2-3 feet deep, I have seen a mass of probably one or two hundred swimming all herded together like tadpoles. Although I have not actually seen the parent fish myself, all the local busti-wallahs assure me that the mother is always close by and will protect the young from danger.' Day says—'These fishes take a bait very readily, especially a frog, and are said to rise to a salmon-fly'.

Family : GOBIIDAE.

Genus: **Glossogobius**

30. **GOBY. Glossogobius giuris** (Ham.).

Vernacular names :—*Wartee-poolah*, *Boan* and *Kurudan*, Mal. ; *Nullatan*, *Olloway*, Tam. ; *Tsikideondoa* and *Issakee doondoo*, Tel. ; *Gulah*, Ooriah ; *Nga-sha-boh*, Burmese ; *Poo-dah*, Andam. *Ab-bro-ny*, Canarese ; *Goo-loo-wak* and *Boul-la*, Punj. ; *Gooloo*, Sind and N.-W.P.

$$\text{D. } 6\,\frac{1}{8\text{-}9};\ \text{P. } 20;\ \text{V. } 1/5;\ \text{A. } \frac{1}{8\text{-}9};\ \text{C. };\ \text{L. } 1{\cdot}30\text{-}34.$$

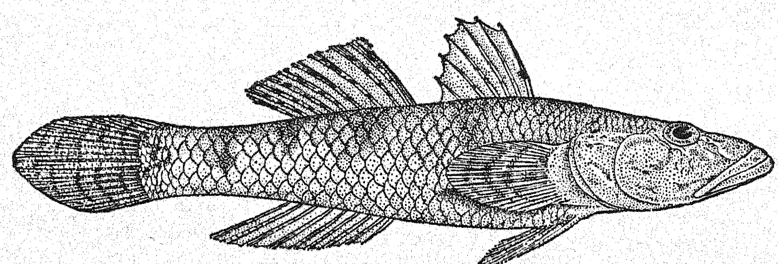


Fig. 58.—*Glossogobius giuris* (Ham.).

This is a widely distributed fish and is found along the east coast of Africa, throughout the plains of India, Ceylon and Burma and Malay Archipelago and beyond. It attains a foot and a half in length. The head is longer than it is broad with a longer lower jaw, its maxilla extending below the anterior margin of the orbit. In the upper jaw the teeth are arranged in villiform rows with an outer enlarged row anteriorly which laterally becomes two rows of which the inner one is sometimes the larger. In the lower jaw also there is an anterior row which becomes double laterally. There are two dorsal fins, the first with a few spiny rays and the rest are all soft rays. The caudal fin is long and may be either pointed or rounded. *Colour.*—The colour of the fish varies with the environment, but broadly it is of a fawn-colour with irregular bands, spots or blotches on the back and sides of the body. The vertical fins are spotted.

SPORTING FISHES FOUND IN BRACKISH SALT WATER.

31. **Megalops cyprinoides** (Brouss).

Vernacular names :—*Punnikown* and *Naharn*, Ooriah; *Moran cundai*, Tamil; *Nga-tan-yonet*, Burmese.

$$D.\ 19\text{-}21\ \left(\frac{2}{17\text{-}19}\right);\ P.\ 15\text{-}16;\ V.\ 10;\ A.\ 24\text{-}27\ \left(\frac{2}{22\text{-}25}\right)$$

$$C.\ 19;\ L.\ 1{\cdot}37\text{-}42.$$

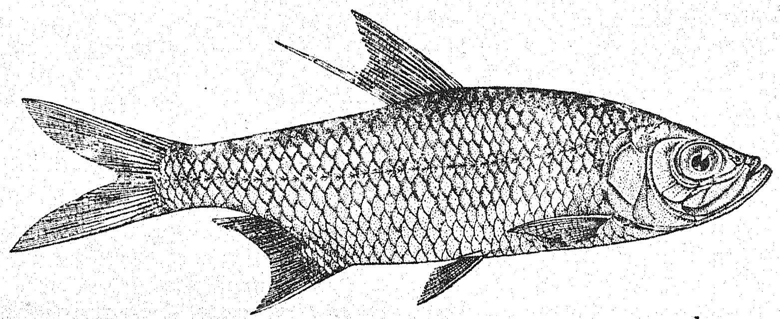


Fig. 59.—*Megalops cyprinoides* (Brouss).

This fish attains a very big size and is found along the east coast of Africa, in fresh waters and estuaries of India, Ceylon, Malay Archipelago, China and Polynesia. The eyes are big and provided with narrow adipose lids. The lower jaw is prominent and the maxilla reaches to opposite the hind edge of the eye. There are villiform teeth in both jaws, on the vomer, palatines and pterygoids. The dorsal fin arises opposite the ventral and about mid-way between the snout and base of the caudal fin. The caudal fin is deeply lobed. *Colour.*—The summit of the head is dark olive while the back is bluish green. The abdomen is silvery with bluish reflections. The sides of the head, the lateral line and the margins of scales are of a brilliant silver. The dorsal and caudal fins are greyish with minute black dots. The margins as well as the last elongated dorsal ray are also black. Pectoral, ventral and anal are diaphanous with some black dots and the last anal ray is dark. The eyes are silvery with a dark tint along the orbital margins.

Cock Up.	*Lates calcarifer.*	These will be discussed in the chapter on Sea Fishing.
Red Perch.	*Lutianus roseus.*	
Bahmin.	*Polynemus tetradactylus.*	
Seer.	*Cybium.*	

English Trout

Family : SALMONIDAE.

32. **BROWN TROUT. Salmo fario.**

33. **RAINBOW TROUT. Salmo iridens.**

Trout Fishing.—This needs but brief mention here, as the few places where the trout has been introduced are either protected by

clubs or by Government, and full and detailed information can be had by application to the Secretary of such clubs, or through the Game Warden, or such other official in charge.

Kulu.—Has excellent trout fishing, and some good fishermen have retired there who could be approached for information and help. The Fishing Club would put one in touch with one of these gentlemen or furnish full details of the water, hotels, etc. One angler wrote me and suggested taking a tent.

Kashmir.—Is too well known to make detailed notes here, and all the information required can be obtained from the Game Warden of the State, or from the many residents, some of whom are excellently informed of the best places and lures.

Ootacamund.—There is a useful little book written by Red Palmer, dealing with the fishing near and around Ooty, and the Nilgiris. It is titled *With Fly, Spoon, and Minnow and Rifle* and acquaints the stranger with the best places, bait, etc.

Kumaon.—The Trout hatcheries at Bhowali have been turned into a bathing pool, but the Guna Lake in Garhwal, high up and right off the beaten track, abounds with Trout; stocked years ago from this hatchery they have multiplied to such an extent that one angler on a recent visit there got tired of catching them, they however, run small.

Ceylon.—Further afield is Ceylon, with excellent trout streams. This concludes my knowledge of the Trout fishing obtained in this country.

Brown Trout has in recent years been introduced in Bhutan, where they are doing well. They have also been stocked in certain parts of the Darjeeling Himalayas.

CHAPTER X.

SEA AND ESTUARY FISHING.

Estuary fish (1). Sea fish (2).
'Angling Around Bombay' by G. D. Traylen (3).
'Note on Sea and Estuary Fishing at Karwar' by Dr. M. Suter, D.SC. (4).
Bahmin in Malabar by Munisheh (5). Sea-fishing (West Coast) by Lt.-Col. R. W. Burton (6). East Coast angling localities by Sri E. K. Mahdavan (7).

From Karachi in the extreme north of the West Coast of India to Cape Comorin in the south, then again all along the East Coast of India and down the Burma coast to the Mergui islands, excellent sport can be had, both at sea and in the tidal portions of the rivers, with Game Sea Fish of considerable size.

It is a subject little dealt with, but one that provides excellent sport, and is as good as in many parts of the world.

Those who seek fuller information are referred to the *Rod in India* by H. S. Thomas, and to the following Journals of the Bombay Natural History Society :—

Vols. 12 and 13. Six articles by Commander Gadsden, Royal Indian Marine :—(1) The Bahmin, (2) Mullet and Gar-fish, (3) Aden and adjacent waters, (4) Andaman Islands, (5) Karachi, (6) Open Deep Sea Fishing.—All are informative and helpful as to seasons, localities, methods and tackle.

Vol. 17, No. 3, p. 620. Estuary fishing, etc., and habits of Nair fish.

Vol. 17, No. 3, p. 637. Protective Legislation for Indian Fisheries.

Vols. 24 and 25. Sea fishing in the Persian Gulf by Major Lane.

Vol. 33, No. 2. List of 369 species of fresh and salt water fish found in Travancore and the sea off its coast, with vernacular names.

Vol. 34, No. 4 and Vol. 35, No. 1. A series of most interesting and informative articles by Sir Reginald Spence (Hon. Secretary) and Mr. S. H. Prater (Curator to the Society) on the Fish Supply of the West Coast of India.

Vol. 36, No. 1. Game Fishes (freshwater) of Bombay, Deccan and in Bombay Presidency, by the same authors.

Vol. 42, No. 1. 'Something about Swordfish' by Lieut.-Col. R. W. Burton.

Vol. 41, No. 3. 'A Visit to the Laccadive Islands' by Lieut.-Col. R. W. Burton.

I give below a short description of the best known fish with their habits and the ways of circumventing them.

1. ESTUARY FISH.

BEGTI : Lates calcarifer. B. vii.

D. 7–8 1/11–12, P. 17, V. 1/5, A. 3/8–9, C. 17, L. 1. 52–60 L.Tr. 6-7/13, Caec. Ply. 3.

Dangera, Sind; *Nuddeemeen* or *Nairmeen,* Mal.; *Paineomeen* or *Koduwa,* Tam.; *Pandukopa* or *Pandu-meenu,* Tel.; *Dur-*

ruah and *Bekkut*, Ooriah; *Begti*, Beng.; *Nga-tha-dyk*, Arrae; *Koral*, or if large *Baor*, Chittagong; *Todah*, Andam; *Cockrup*, *Bagti* Calcutta. *Nair* Madras and Bombay, and commonly known by this name.

Lates calcarifer attains a length of 5 feet and a weight of 200 pounds. Dr. Cretin gives the colouring as 'Grey, shot with green above, silvery below during the monsoons, with a tinge of purple'.

The mouth is armed with minute file-like teeth. They are sea fish, but found with the Bahmin frequenting the Estuaries. They have a humped back, and are caught on spoon or better still the small grey mullet, which they relish, and is the most killing bait. The live prawn also is an excellent bait. It is claimed that owing to their nocturnal habits and large eyes they are to be taken in coloured water, so this should not deter one from fishing for them. They are very game fish, and the heaviest of tackle (same as for heavy mahseer) should be used. They are an excellent table fish and provide the chief fish supply for the large towns of Calcutta, Madras, and Bombay.

Spin your bait slowly and rather deep, as he takes the bait in a slow matter of fact way. The best time to fish for the Nair fish is in the middle of the day and in coloured water; in the case of clear water, fish from sundown onwards. They are easily located by the loud splashing that goes on while they are on the feed; in fact this is the indication to stop, as after they have ceased breaking the surface of the water, you can abandon any further hopes of catching them.

RED PERCH: Lutianus roseus. B. vii.

D. 10/14, P 16, V. 1/5, A. 3/8, C. 17, L. 1. 48, L. Tr. 57/50, L. Tr. 7/18.

A small fish running to 5 pounds. Colour given by Dr. Cretin, 'dark reddish brown becoming dull cherry red below'.

Also caught by spinning with lighter tackle in smaller water near the banks, breaks water quietly, and his dark form can be seen rising near rocks.

BAHMIN: Polynemus tetradactylus. B. vii.

D. 8 1/13-15, P. 17 iv. V. 1/5, A. 2-3/15-17, C. 17, L. 1. 75-85, L. Tr. 8/14. *Coec pyl.* many.

Habitat; Seas of India to the Malay Archipelago and China, Colour is given by Dr. Cretin 'white filaments on breast, silvery green above, yellowish below'.

This species may attain weight of 40 pounds. Day's '6 feet and upwards in length' is very doubtful. This is the best of the Estuary fish from a sporting point of view, besides the gamest looking. The mouth is set below with the upper portion carrying the nose very prominent, with a bold large eye. The mouth is armed in a similar way to the Nair fish with very fine file-like

teeth, which are unfortunately a protection against a good hook hold. It is a very powerful and game fish, as its shape would

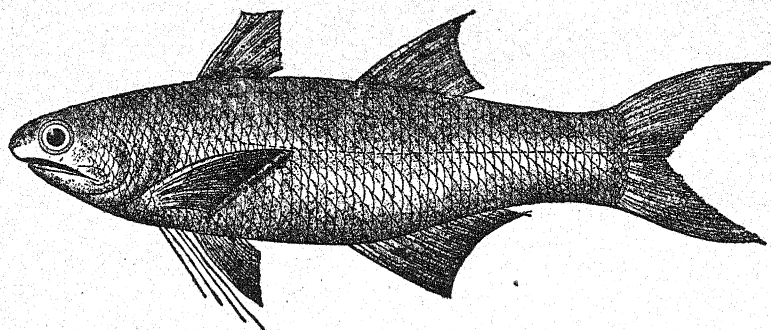


Fig. 60.—The Bahmin (*Polynemus tetradactylus*).

indicate. It lies in the back waters and swift runs where the water is forced through a bottle-neck at either incoming or outgoing tide, and where they can take the small fish at a disadvantage.

Col. Osborne, who Thomas quotes as an authority on these fish, mentions that they are to be taken in the eddies and near piles and piers of old wooden or iron bridges; where the water is broken and the swirls and eddies are a certain find. He also states that it is very important to first detect these fish feeding, which is easy by the splash they make on the surface sending out spray in every direction. The ebb, or flow, of the tide seems to be the indication to start feeding. The young grey mullet is the dainty morsel these fish fancy and provides the best bait for their capture. Thomas amusingly puts the opinions of a number of anglers as the 'Bhamin Committee;' this was in reality the vote of majority on the best time to fish, and it appears that, with Col. Osborne, they agreed that the ebb tide or just after provides the best sport.

He has a characteristic rush like the mahseer and must be given full rights, or a break is inevitable. 'Killin' wire traces and stout mounts and hooks as for heavy mahseer, are imperative if you want to do well with this fish. But be careful as to 'killin', it rusts very rapidly. Bahmin are occasionally taken on spoon, though phantoms and spoon are less productive than mullet, which provides certain sport if the fish are feeding. Here I can do no better than to quote from the 'Rod in India' of how to fish for Bahmin.

'Having now mentioned rods, tackle and baits, I turn to the actual capture of the fish. As I have already said, when the tide steadies into a regular stream you will, if standing on a bridge soon see the mullet and other small fish darting in different directions and the Bahmeen (Bhamin) dashing after them. Commence spinning at one end of the bridge by throwing out as much line as you can control; let the bait trail and spin in the water, and be careful to spin well over those spots where you have seen the fish rising. Hold your rod with both hands across your chest, with the point rather elevated, and without making another cast walk at such a pace as will keep the bait spinning nicely to the other end of the bridge. And now

comes the question, which is the best side of the bridge to fish from? This is an important point. The best side of the bridge is that towards which the stream is running, the reason being that mullet always work up against the stream, and the Bahmeen (Bhamin) always lie in wait for them on that side of the bridge, towards which the stream runs, so that as the shoals of young mullet toil slowly up against the tide and make their way through the arches of the bridge they fall an easy prey to the Bahmeen (Bhamin) which are lying in wait for them and hiding behind the piers and piles of the bridge on the other side. When there are a large number of fish about, they can be caught on both sides of the bridge; but the rule I have as regards what I may call the stream side, should be adhered to'.

Thomas (2nd Edition pp. 208-209) mentions another of the family. This is:—

Polynemus Indicus.

B. vii, D. 8 $\frac{1}{13-14}$, P. 15 + v. 1/5, A. $\frac{2-3}{11-12}$, C. 17, L. l. 70–75

L. Tr. 7/13. Vert. 5/19. *Caec. pyl.* many.

'This species has five pectoral rays reaching nearly to the anal fin. Air vessel long and narrow. Vertical fins dark edged. *Habitat.* Seas of India to the Malay Archipelago and Australia.' Day also says, 'It attains 4 feet in length, but is rarely above 20 lbs. weight.'

This is the fish known as *'Dara'* around Bombay, and as Tamil, *Tahlun-kala;* Mal. *Yeta*; Mahr., *Bhāt.*; Aarracan, *Lukwah.*; Burma, *Katha*, or *Ka-ku-yan*; Tavoy, *Kwey-yeng.*

2. Sea Fish.

Five species—The best known localities for sea fishing are the Andamans seas, probably because of the small European community who find it their lot to do three or more years duty in these prison islands, and who turn to fishing as their only recreation. Having no shooting to fall back on, they turn to what proves to be as good sport as any, and a variety of fish of all sizes is taken. Not that I would admit for a moment that it is better than fishing anywhere along the coast from Karachi to Mergui, but we find that most of our information is gathered there, and will serve our purpose, as the baits and methods are the same as for any localities where these fish occur.

The local fishermen will soon put you on the ways of catching and finding the many varieties.

Punjab wire is probably the best for traces with ordinary Catalina line. Large sea reels and Ringal rods provide the tackle with strong hooks to stand up to a bite of a powerful fish, armed with a mouth of file-like teeth.

Sardines (*Clupea longiceps* and *C. fimbriata*) which appear in large shoals at times, are the best bait for the open sea fishing, they are thrown out away from the boat, till the fish are noticed feeding which is registered by swirls; then the liveliest of your bait is attached to the hook and cast in amongst the feeding fish. The presence of these fish is also an indication of the arrival of the Khokari, which follow the shoals and take their toll.

The Seer or Surmai, *Cybium* allied to the Mackerel, grows to 6 feet in length. Colour is given by Dr. Cretin as 'bluish above, silvery below, with blotches. Altogether a sea fish. Scaleless, finlets on back.' They have a large head, and mouth full of formidable teeth. The larger ones are taken well out and away from shore, where 50 and 60 pound fish may be caught, and they put up a grand fight.

Khokari (*Caranx*) (Andamans) many varieties. This is a handsome fellow, perch like in appearance, full and deep body slightly compressed, scales small and resplendent, head small and shapely, high backed with strong tail and fins. The pectoral fins are long and scythe shaped, colour goldish. Body is bluish silvery sheen on the back, to a golden white below, they run up to 100 lbs. or more. They are found in shoals of 20 to 50 with the fish all averaging much the same size, are excellent table fish, and take pride of place as a game fish in the Andaman Seas.

The other sporting fish are all caught in much the same way.

The Barrachuda (*Sphyraena*), (several varieties) or dog-fish, is a good fighter and runs to 105 pounds in weight (West African record): ordinarily the size met with is 15 to 30 lbs.

Gobra (*Serranidae,* sea-perch family) a kind of rock cod. It is shy, ugly and heavy. When hooked it bores down and sulks, and gives endless trouble before it will move.

The Bonito (*Thyanuspe-lamya*) seldom taken, but a game fish, boring right down to the bottom the moment he is hooked.

Mackerel, Grey Mullet, Gar fish are also taken and the usual limit in weight is 10 pounds for the last named.

Tunny, Rays, Sharks, Indian conger eels or Wam (*Muraenesox*), Ghol (*Sciœna*), and Bahmins are also to be had for the seeking, and I can here only suggest to anyone interested to obtain all their information from Vol. xxxiv, No. 4 and Vol. xxxv, No. 1 of the Bombay Natural History Society's Journals. The fish of the west coast are dealt with well, and in detail, therein.

For the Sharks, Rays, and Tunny, Sea fishing books will direct one as to tackle and lures.

I reproduce notes on Angling Around Bombay by T. D. Traylen, on fishing around Karwar by Dr. M. Suter and a note sent to me by 'Munisheh', on Sea Fishing in Malabar,[1] which throws yet another aspect on the methods to be worked through and tried, while fishing for Bahmin, Seer, etc.

3. Angling Around Bombay.

BY

G. D. TRAYLEN.

Of Votaries of the Rod resident in Bombay, comparatively few practice or give thought to this form of recreation, although

[1] Reprinted from the Journal of the Bombay Natural History Society, Vol. xxvii, No. 3, pp. 535-539.

excellent fishing is within easy reach of anyone seeking it. It may be that it is not generally known, what fish are to be taken, where to look for them, or what gear to use; others again, may possibly have made an attempt, but owing to their venture having been made at the wrong time and place, results were not conducive to further trial. In as few words as possible, I will endeavour to write down my experiences regarding: Firstly, the Fish which may be taken, secondly, Places where they may be found and lastly, Suitable Tackle, and Lures.

The Bahmin (*Polynemus tetradactylis*), local vernacular, 'Raos,' comes easily first as a really good fighter who gives excellent sport. He takes the lure with a rush, gives several runs, and is not one's fish until actually in the boat, moreover he is good for the table.

Quoting the late Mr. Afalala, as an authority, 'the Bahmin is stronger weight for weight than the Salmon, quite as game and without the vice of sulking'.

The Begti (*Lates calcarifer*), local vernacular 'Dungara' or 'Kajura', known in Southern India as the 'Nair' is another excellent sporting fish.

When angling for Bahmin and Begti one occasionally is taken by a 'Seer'; this seldom happens, as he rarely comes into the estuaries, but the 'Gobra' or Rock Cod, the 'Tamas' a species of bream, the 'Powla' of the Shad family will take the same lure, a small Shark sometimes bolts the bait, and if too near the bottom, a repulsive series of Eel will intrude, and give some trouble in cutting away and bending on fresh gear. I limit further remarks to the Bahmin and Begti, these two fish being best worth attention.

The Bahmin may be taken anywhere in Bombay Harbour and round the Coast, where a strong current runs over rocks. The Shoal at Sunk Rock Beacon is a favourite haunt, but he will be found off the Prongs Light House and in the openings through the reef which extends from Colaba to Malabar point; at the Kansas Rock or Gull Island, the Shoal at Middle ground Battery, at Tucker Beacon, Hog Island, and as far up as the rocks at the Customs, Bundar, Thana, and he no doubt feeds at other places in the harbour where the tide runs strongly over a rocky bottom. Though Bahmin may be present, one never gets a run excepting at the very end of the flow at slack water and during the whole of the Ebb tide.

From August to October he will certainly be in evidence at these times of tide; from November to May he is somewhat irregular in attendance, in June and July he may possibly be present in force, but few would care to venture in the early part of the monsoon, because of Squalls and the heavy combers which roll over the Shoals. Sometimes the Bahmin comes up stream in numbers, and takes voraciously for about an hour or hour and a half, at other times he takes right down to the last of the ebb, so that one need not be discouraged should there be nothing doing for an hour or so after anchoring, for he well repays a little patience. I have already stated that the Begti is occasionally present in Bahmin waters, but in the monsoon months he ascends the creeks and rivers and will be found beyond Kalyan, a good pool for Begti during August and September is near the Railway

Bridge over the Ulhas river at Kalyan going north, *i.e.*, towards Titvala, this pool will be seen on the left hand side of the bridge and near the right bank of the river. A deep channel through the rock opens out into a broad reach, in appearance somewhat like the neck of a bottle, and the pool is just where the neck joins the shoulder. Unless one has a boat it is better to approach from the left bank and cast from the rocks. A small silvery fish which the native fishermen will procure, or a live prawn, floated two to three feet beneath the surface are the best baits, although a spoon or silver devon will answer when the stream runs strongly. Heavy fish of 20 to 30 pounds are taken here. Begti frequent many other places on the Bassein Thana Creek, the rocks where the stream narrows near the Collector's bungalow, Goa Bundar, the rocks in main stream Parsick, the small creek which runs under the Railway Bridge at Mumbra and two places further up that creek, one being the rocks opposite Diwa and the other pool immediately below the stone 'bund' rather less than a mile higher up (it is desirable to have a boat to negotiate this creek). In the main stream from Mumbra to Kalyan there are several rocky shoals, notably one about a mile below Kalyan and another close to the new bridge which leads to Bhiwindi. Undoubtedly the Begti is in the river from its mouth to the higher reaches, and many other likely spots might be found by drifting down stream on the Ebb near low water, taking bearings of those places where rocky obstructions create a rapid stream, for Begti appear to feed near the exits of passages through boulders and in the eddies caused by such obstructions.

The question of Tackle is productive of unlimited controversy, most Anglers have their own theories and favourite rods, but it necessarily follows that as all men are not physically the same, a rod which the one handles with ease would be too heavy and fatiguing for another less robust. When fishing from a boat in salt water, rods are subject to rough usage, and unless one is particularly careful, sun, wind and weather plus occasional collision with the boat or its fixtures and, last but not least, the pull of the stream plus that of the fish will speedily put a perfect weapon out of gear.

The ordinary shop 'Sea Rod' appears to be made especially for the Cod, Plaice, etc., found in home waters, and is no more suitable for Bahmin and Begti than it would be for Bass. Almost any rod will serve providing it is sufficiently stiff to comfortably carry the weight of sinker and lure plus the pull of the Stream. Without deflecting more than about 300, it should bend throughout its entire length, for many rods I have seen in use have had a good top, but being too stiff in the butt joint the result has been a break when the Bahmin has made one of his sudden rushes, or when giving him the butt prior to gaffing. For preference, I would choose a two jointed rod with whole cane butt and green heart top, in length from 8·6 to 10 feet and sufficiently light to enable one to make a cast of about twenty yards with one hand.

If the corkgrip is tightly wound over for about twenty inches, with strong hemp cord, it makes a firm hold in all weathers. In play it should bend in a half circle or more from butt to top, and

not merely from middle to top in the form of a hook with a long shank; the reason for this will be appreciated when one is playing a Bahmin whose steadfast purpose is to run under the boat and cut the line, or bore for the anchor rope to the same end. The Bahmin has no teeth, but his mouth has a hard bony ridge serrated like a file and he is frequently held by one barb of the hook catching under this, it is the spring of the rod which secures the hook hold and the hook becomes free as soon as the net or gaff takes the weight of the fish. Too supple a rod is not desirable for two reasons. 'A' one has to remember that frequently the fish are on feed for only an hour or two hours, and too supple a rod means longer time in getting him to net and many chances are lost. 'B' is rather a tax on the good nature of one's companion, if fishing in company, it being expedient that all other lines shall be reeled up when a Bahmin is being played. A good Calcutta Ringal (Bamboo) silk lapped in two or three places in each segment, the butt packed and lapped with good hemp cord for about twenty inches, good brass winch fittings and 'Snake' rings of copper or brass wire (not iron or steel) will render good service. The winch or reel should have a large drum for rapid recovery of line, Nottingham pattern reels with optional check and line guard are excellent, size not less than four inches and five inches for preference; brass lining is desirable as it almost eliminates the chances of a jamb. Those Anglers who have reels of the old pattern with small centre spindle, may get useful work from them, if a few yards of stout blind cord are first wound on the spindle before reeling on the backing line. The importance of getting line back *quickly* when the fish rushes towards, instead of from, the boat when struck, is obvious, especially as one does not know whether or not the hook is fairly home or merely engaged with the hard bony ridge he has in lieu of teeth and gums.

It is desirable to pay particular attention to the business end of the line. *Eschew gut and Gimp*, and mount all hooks on fine steel wirt, for the Bahmin is an adept at gymnastics and his gyrations are fast and furious in his endeavours to bottom and, aided by the rocks, rub the annoyance from its jaws; he will also bore away head down and repeatedly thrash the trace with his powerful tail. This matter may be considered as of vital importance, for unless a good hook hold is secured, all else is of little consequence. Stout 'Eyed trebles' are very satisfactory in use and numbers 3 and 4 the most useful sizes. The hook *must* be stout or it will straighten out in playing an average fish of seven pounds weight. A very useful method of mounting hooks, is to twist a loop in a short length of steel wire, this loop being sufficiently large to pass easily over the eye of a treble and down its shank, the free end of looped wire should be turned twice and secured through the eye of a second treble, so the looped mount should measure over all about one and a half inches from top of loop to top of eye, a pair of round nosed pliers is a useful tool for this purpose and also for bending on wire traces to swivels.

In using hooks so mounted, for Bahmin take an unmounted treble we term the Lip hook, pass the loop of *mounted* treble over the eye of lip hook, the trace is attached to this lip hook, one barb of

which is passed through the nose of live bait, and one barb of mounted hook is inserted in the side of bait between the pectoral and dorsal fins. The Bahmin invariably attacks the head of live bait, if spinning live or dead bait the loop of a second mounted treble may be passed over the first mounted treble and one barb be inserted in the bait, midway between the Ventral and Caudal fins, so as to curve and to make it spin. This tail hook should always be used from August to November, as Begti and Seer are then occasionally present, and as they make a rear attack, the lure should be so guarded. Without diagrams, this description has necessarily became somewhat lengthy, but I think the importance of a good hook hold is paramount and the merits of this particular method of mounting is, that it is extremely simple and convenient, moreover, one can depend upon it.

For traces, I do not think there is any thing better than steel wire, 'Killin' wire is very good, and so is the wire from galvanized steel rope, this may be obtained in all sizes, and a six-foot length will provide a number of good traces and hook mounts, besides giving one's servant a little amusement in untwisting and separating it. A useful form of trace is about two feet of stout wire bent on to a double swivel at one end, a single swivel at the other, to the single swivel attach about four feet or less of fine wire the free end being bent on to the eye of the lip hook already described. The Weight or Sinker must not be forgotten, as so much depends upon having the bait at the right depth. The Tide Tables given in the daily papers show the great variations in rise and fall, and the strength of stream naturally varies with the height of tide. A convenient type of weight is an oblong of $2 \times 1\frac{1}{2}$ inches with holes at the two top corners through which a length of line folded to from a six-inch loop, one end of the weight, and another loop of about an inch at the other end. The long loop is bent through the double swivel and serves for adding extra weight if required, the free end of casting line is attached to the shorter loop. This form of weight also serves the purpose of an 'anti-kinker' which prevent one's line from twisting. Sinkers may be made of aluminium, brass, and lead; several of different weights are necessary, from aluminium which is extremely light to lead weighing up to six ounces, of course, any other form of sinker will answer the purpose, but the thin metal 'anti-kinker' should not be omitted for in practice the comfort of it will be appreciated. Of lines there are many, a very useful one is a length of about twenty-five yards of number 3 or 4 plaited silk dressed line, bent on to 100 yards of plaited flax backing. One can cast out twenty yards or so of silk dressed line with a turn of the wrist, and the 'anti-kinker' referred to above ensures it coming back without twist, every time.

When using live bait, the boat man will procure such in advance or will catch them with hand lines when the boat is anchored at the place one is angling from; it is always expedient to take a few mullet of about four inches, to provide against a shortage of live bait; they are generally procurable in the bazar and may be spun on the same mount. In August and September a four-inch Silver Devon or a two-inch spoon is possibly the best

lure on a strong tide, and live bait or spun mullet if there is a tide of less than six feet. As the bottom over most shoals is particularly rough and scraggy, it is better not to cast when the tide is low and weak, but to use a float to keep one's gear from fouling. The float should be so arranged that it may be easily released when one has a run, a fixed float meaning almost certain disaster.

When the Bahmin is present in force and on the feed, he takes anything going without being particular as to the manner in which it is offered, at other times he has to be searched for and humoured. When the stream is running strongly one has only to pay out line a few yards at a time with a sink and draw motion, the stream carries out the lure, and the Bahmin will make his rush. By this method one is always covering the same stretch of bottom backwards and forwards.

When there are fewer fish about, one needs to cover more ground and search for them, rather than to hang out one's line in the hope that he will come along presently—here let me digress with a note of warning; *never to lay down a rod, with a baited line in the water*, unless first taking the precaution of securing the butt, for at any moment a rush may come, and the rod be snatched from the boat. An effective and killing method of searching water may be explained by referring to the dial of a watch and to assume one's boat is anchored in the centre with the stream running strongly towards 12 o'clock; swing in the bait and let out from 20-25 yards of line, then with the left hand draw in a yard or so of line at a time with a sink and draw motion, coil up line on seat of boat then cast out about 20 yards or so, so that lure strikes the water at about 7-30. The bait sinks with a curve and then rises with a curve at about 10 and swings round to 12. Recover line as before and try the same cast at 5-30, the bait will sink and rise and continue round to 12 again. If not taken, repeat these casts and in successive throws reduce the radius a yard or so at a time, until all the water in $\frac{3}{4}$ of a radius of about 20 yards near the boat has been tried. If no result, leave line out at 12 o'clock, secure the rod, and rest a few minutes, for it will be fairly safe to assume that no Bahmin are present, otherwise in the area of water covered a touch would be almost certain. Sometimes he takes a devon or spoon immediately it touches water, but in most instances, his rush is made when the lure is rising on the upward curve. One must be particularly careful to *feel* the lure when it is at right angles to the boat, that is about either 9 or 3, as if the current is not strong and the weight is heavy one catches the bottom and this means loss of part of line with its appendages. If one has the bad luck to get so caught, it is sometimes possible to get free, by pulling the line nearly taut and to put the helm over so that the current will swing the boat over the entangled bait, when an upward pull immediately over it, will often effect its release. To get in to the proper position to perform this operation, it may be necessary for the boatman to unhitch and pay out a few more yards of the mooring rope, and it

is expedient to be sure this means is provided for when anchoring, as some boatmen would let out all the cable at the start.

Occasionally one will observe Bahmin rising and swirling all round the boat and yet not get a run, at these times plenty of natural food may be in the water, and he has no use for one's carefully prepared lure, however a nice prawn or a small spoon or Silver Devon cast at right angles to the boat, will sometimes induce him to make a mistake.

Sea water is particularly rough on tackle; on returning home it is a good plan to drop all hooks, traces and artificial baits into a basin of water in which a little common washing soda has been dissolved; after a few minutes, remove, drain and hang up to dry, then oil and put away for further use. Line should be reeled off into a tub of fresh water, be left to soak for half an hour and then be drawn through the hand to remove as much water as possible and afterwards be wound on a line-drier and then be left in a draught until dry; unless this is done, line quickly rots. Rusty steel mounts and traces are not safe to use, nothing will emphasise this more forcibly than the loss of a fish which has made a good fight and in the end has gained his freedom through defective trackle.

In conclusion, I might say, few boat-men can be trusted to use the gaff; in spite of coaching they *will* strike at, instead of pull into, the fish. They make better use of a landing net. The average weight of Bahmin taken in the Estuary is seven pounds and fifteen pounds is the limit, out at sea they run heavier. The tackle described and methods of use are not claimed as being the best, they are at least effective in all round practice and ensure sport. At Sunk Rock, one may often observe the Light-keepers haul in fish after fish, by means of a stout pole with a length of signal line to which is attached a yard of stout brass wire, and for lure a six-inch Silver Devon; they are out to catch, and the fish has no chance, but is simply hauled round to the net if well hooked. Any one with almost any sort of tackle will catch Bahmin at times, but there is little satisfaction in going for thêm with gear which would hold a whale. The Bahmin is a really good sporting fish, he stands up to one and fights to the last and there is satisfaction in knowing that the light strong tackle one is using takes fish when coarser gear does not; moreover, after playing a fish he sometimes gets the best of it and is never ours until he lays kicking in the bottom of the boat, his big eyes seeming to express astonishment at finding himself there. A blow on the head puts him out of his misery, and it is well to remember this, especially if a 'Gobra' comets to the net, as this fish lives for some hours out of water and one is apt to regret should he be bound gasping in the basket when arriving on shore. Bahmin, Begti, Seer and Gobra are quite good for the table, one's friends appreciate *freshly caught* fish and when a good catch has been made there are Hospitals and other Institutions where such gifts are welcome, thus we may have the satisfaction of knowing that although our sport has entailed the taking of life, the victims have in the end fulfilled their natural destiny.

4. Sea and Estuary Fishing at Karwar.

BY

M. SUTER, D.SC.

Experience gained in six seasons' fishing and study of fishes at this delightful spot encourages me in jotting down these notes at the request of Mr. Prater, mainly for the benefit of brother anglers, who might find them useful.

Of all places on the West Coast, Karwar is probably scenically the best favoured. The spacious bay on which it lies, with its long and gleaming sandy beaches, is bordered to the south by the rocky and jungle-covered Karwar headland, terminating in Badchidar point.

At the northern end of the bay, where white capped breakers mark the sandy bar off the estuary of the Kalinadi, we find the large islands of Kurmugad and Sungiri, locally called Madlingad.

Kurmugad is well wooded, and crowded with an old fort probably built by the Sounda Rajahs, whereas Sungiri, separated from it by a navigable channel, is rocky and forbidding.

Kurmugad holds a pretty bathing beach and is the venue of a pilgrimage in honour of an aboriginal deity.

The wide vista of the ocean is dotted with a group of several islands and rocks situated about 1½ miles west north-west of Badchidar point in front of which is Elephant island. These islands are about 4 miles from the inner harbour of Karwar and must be described in some detail, as they are the main fishing ground for Bahmin, etc.

The southernmost is just a jumble of rocks locally known as Karkalli. A little to the north-west rises an isolated rock spire, beyond which lies a flat rock-island separated by a channel from the high and well wooded Little Devgad island, which Pilot books appear to call Karkal. It is rocky and foul on all sides, and separated by a channel from the main island, Devgad, which is 140 ft. high, well wooded and carries the lighthouse and other buildings. It has a landing shed and in ordinary times was a delightful picnic place.

To the west of Devgad, and separated from it by a fairly broad and deep channel, we have a rocky island with several prominent rock towers, forming favourite perches of beautiful sea-eagles and the peregrine falcon. This is locally known as Mothe.

A little south of Karkalli there is a submerged rocky plateau from which arises a pyramidal rock, well visible at the halftide. This is locally known as *Burkia*, the drowning place, on account of an old shipwreck tradition.

At the back of the southern end of the bay rise densely forested hills, culminating in the rocky top of Gudehally, whose bold outline forms a fitting background to the general loveliness of the picture of the bay, as seen from Devgad island.

Beyond Karwar, to the south-west, lie the pretty bays known as Cemetery and Bingi bays, separated by Baitkal point; and facing Binge bay we have the large and picturesque island of Anjedive, a Portuguese possession.

The town of Karwar is a district headquarter with the usual set of Government officers and garrison of district police. There is a market and various shops and artisans, a good hospital, a Dâk bungalow and last, but not least, the Grand Hotel, where Mr. D'Souza provides welcome sustenance and accommodation.

On the various beaches pleasant bathing with or without surf may be enjoyed at all times except during the monsoon, when the surf is too heavy. Sharks keep too far out to be a danger, jelly-fish are not more than a very occasional nuisance, and stingrays are evidently quite rare and infrequent visitors of these sands.

From the fishing point of view Karwar suffers by the general disadvantage of this coast. Its very gradual shelving towards the ocean places even such a moderate depth as 15 fathoms quite beyond the reach of the local fishing canoe. This limits the list of available game fish to such predaceous species as come in with the tide in pursuit of shoals of migrating sardines and small mackerel, which frequently hug the coast, perhaps for the compa-rative safety, of shallow waters.

Thus the angler really depends on visiting fish in quest of food and on such others as use the tidal estuary of the Kalinadi for spawning.

The only true residents of sufficient avoirdupois, worthy of the angler's notice are the Serranidae or Gobras, which seem to be present throughout the year.

Depths of 50 fathoms and over, where one could meet the lovely dolphin, nimble bonito, sturdy yellow-fin tunny, rushing wahoo and lordly sailfish and swordfish, can be reached only by high-powered seagoing motor cruisers, and these fine sporting fish must, on this coast, remain a fisherman's dream for a long time to come.

The tidal nature of most of the local fishing limits profitable activity to a few hours a day, and a further limitation is imposed by adverse conditions of wind and weather. However, these drawbacks, inherent in all coastal fishing, have to be accepted with resignation.

The main element influencing fishing in these parts is the pre-sence or absence of shoals of small fish, such as certain species of *Engraulis, Clupea* and that very tasty little mackerel the 'Bangra'. During their migration, they may or may not enter the bay and hug the coast. These myriads of gregarious fish not only bring welcome supply of sea food to the inhabitants of the coast, but also bring the larger predators within the angler's reach.

The main exceptions are such habitual visitors to tidal estua-ries as the Bahmin and the Cockup or Begti, the first of which used to provide the chief piscatorial attraction of the region, spawning every October in large numbers up the Kalinadi.

Under favourable circumstances Karwar certainly offers not only an interesting list of hard fighting and beautiful game fish, but also a chance of making catches which can hardly be bettered anywhere else on the Indian coast.

THE FISH.

A short description of the main sporting fish of the region ought to be all the more welcome to the angler, as most of the

literature dealing with the subject is nowadays not easily procurable.

By far the larger number of sporting sea fish to be encountered by the visitor belong to two families:—the *Serranidae* or Sea-Perches and the *Scombridae* or Mackerels.

The main exceptions are:—

The Bahmin, belonging to a family of purely tropical fishes, the *Polynemidae*.

The Barracooda or Sea Pike (*Sphyraenidae*).

The Gar fish (*Belonidae*).

The Wolf Herring (*Clupeidae*, genus *Chirocentrus*).

The species of real interest to the sporting angler are the following, given more or less in the order of their importance:—

The **Bahmin** (*Polynemus tetradactylus*). Locally *Rawas* or *Ramus*.

This game and well shaped fighting fish, running in these parts to a maximum weight of 27 lbs., used to provide, for very many years, the main attraction to local and visiting sportsmen. It could be relied upon to appear every year from July to October in schools of a dozen to over a hundred, coming in and going out with the tide.

Whereas the heavier fish frequented by preference the vicinity of the islands of the lighthouse group, smaller ones could be relied upon to haunt the channel between Kurmugar and Madlingar islands, and the water outside the bar.

When swarms of 'sardines' invade the estuary Bahmin often cross the bar in pursuit of their prey, ascending the tidal river quite a long way with the tide. They seem then to remain for 1-2 hours just inside the bar at the last quarter of the low tide, offering splendid sport to the expert bait caster.

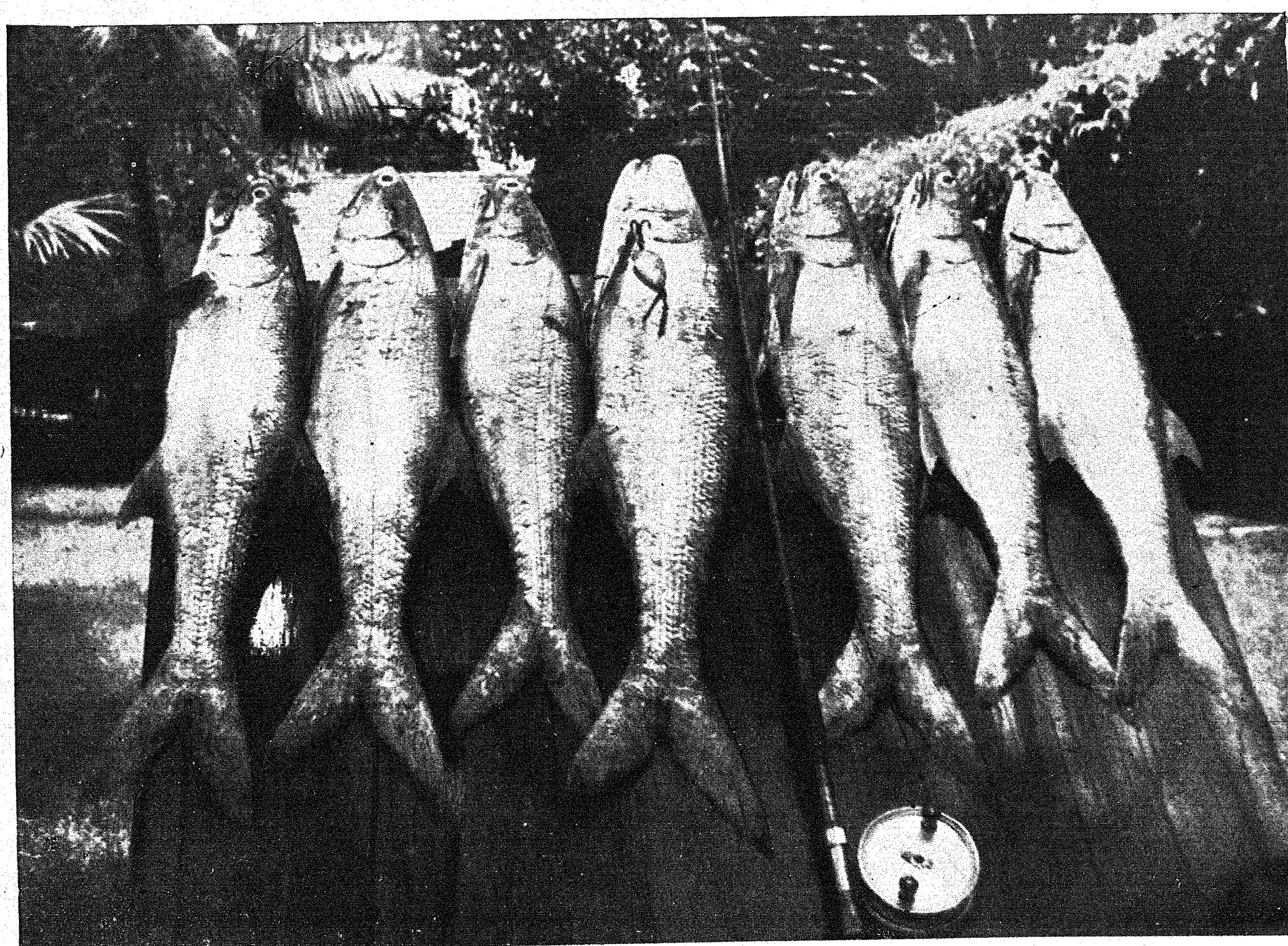
Even as early as end of August, the Karwar Bahmin contain some spawn, which they develop in September, then, sometime in October, they went up-river for spawning.

On completion of this business the swarms evidently disbanded and went out to sea, at all events after October only very rare stragglers have been caught.

Up to a few years ago very fine catches of a dozen and over could be made in a day by a single rod fishing out a tide at the islands. Unfortunately, and for unknown reasons, the influx of Bahmin into Karwar bay has steadily diminished during the last 4 or 5 years, and there were hardly any at all last year. Whether this is due to some catastrophic calamity, or perhaps to adverse conditions affecting their habitual spawning ground such as silting up, must at present remain in the domain of pure conjecture. We can only hope that things will mend again, and we that may look forward to a revival of the fine sport these fish used to provide.

The Bahmin is a finely shaped, somewhat salmon-like fish, with a prominent nose. Its mouth, set well underneath, and provided with large plates of densely packed villiform teeth, offers a poor hookhold, except in the corners.

The eyes, very large and placed well forward, are completely covered by a thick transparent membrane.



Part of a catch of Bahmin: heaviest $25\frac{1}{4}$ lbs.—Karwar.

The somewhat thickset body and very sturdy caudal region denote speed and power, which this fish indeed possesses to a degree.

The body is fully covered with hard and moderately large scales of a silvery grey colour.

The main distinctive feature of the species is 4 free rays set in front of the pectoral fins which, have given the fish its name *tetradactylus*, i.e. 'the four-fingered one'. There are two separate dorsal fins.

The bladder provides some of the best fish glue, and the flesh is firm, white and very tasty, whether boiled, fried, baked, broiled or smoked. It is one of the best table fish of the region.

Anyone who has ever hooked a 20-lb. Bahmin in open water on reasonable tackle will have nothing but the highest praise for its fighting qualities. Indeed, the speed and length of its initial run are then very satisfactory, and the power and obstinacy of resistance quite surprising in a fish of its size.

Smaller specimens frequently adopt leaping tactics and not infrequently succeed in throwing a poorly placed hook.

Unfortunately schools of feeding Bahmin are rarely encountered in open water, except when there are shoals of travelling squid about. They are more often met with close in to the island faces, preferably in spots where waves break on the rocks and create the lively turmoil, which they love. There they feed on the ever present rock crab and other small fry. In these places the depth is shallow and the bottom a jumble of boulders, densely covered with rock oysters, clams and barnacles. The instinctive and instant reaction of a hooked Bahmin is to dive for the nearest rock and to dash around it, when even a moderate tug suffices to sever one's line on the razor sharp shells.

Disaster is therefore swift and certain if the fish is allowed a run in such a spot. From the moment a strike is felt the fish must be firmly held and dragged away, while the crew pull the boat some 30 or 40 yards into the open, which good men will effect in a few seconds. During this time the line must be allowed to slip out just enough to prevent a break. Once well away from rocks the fish may be played. The necessity for such tactics explains why comparatively heavy lines have to be used. The power of the fish, plus the resistance of its body against this rapid dragging through the water, frequently against a good deal of current, totals up to quite a considerable strain.

It is to be regretted that this dragging process, short as it may be, necessarily deprives any but the most powerful fish of a good deal of fighting power, and fish so caught never show the spirited fight put up by those hooked in the open. They can be brought quickly to gaff. Even so fishermen will appreciate a pause after landing half a dozen good ones.

Hooked Bahmin occasionally seem to go completely berserk, and I have repeatedly known them to beach themselves by running ashore, or leaping onto flat rocks, where they flounder about helplessly.

By far the most glorious Bahmin fishing used to be had by the 'old salts' who turned up in the second half of August, when

the sea shows still a good deal of life, and when a really good surf beating against the rocks, creates quite a spectacular turmoil—Just what the Bahmin loves!

A good crew will not hesitate to shoot their craft into and through the *tamasha*, yelling at the top of their voices. Great 'whitecaps' threaten to break over the boat or to fling it on the rocks, whilst, only too frequently for the peace of mind of the angler, a yawning blue chasm opens between the brittle craft and the rock. The only thing to do then is to trust to one's luck and to cling to the rod as grimly as possible. The whole thing is a matter of a few most exhilarating seconds and, in spite of frequent dousings, the consummate skill of the crew invariably wins the day, and one emerges from the ordeal with a fine Bahmin as often as not straining at the end of one's line. What, I ask you, could possibly be more exhilarating. Even if one's topee has to be retrieved and the boat to be bailed out now and again, what matters so long as they are biting?

In September and October much quieter conditions are the rule. Nothing exciting may be met with, but occasionally the trip to the islands may resolve itself into a succession of ascents and descents of great, calm and well spaced 'rollers'. Then at one moment the boat seems to be hung up on the top of a ridge, the next moment it is at the bottom of a trough with a steep wall of water in front, another behind, and a bit of watery sky overhead. In fact just that pleasant scenic railway feeling!

The Mackerels.

This family provides us with some of the best acrobats and speed-merchants in the medium weight line, but it is unfortunate that the star performers like sailfish and the marlin are out of reach at Karwar, and must be sought for in Ceylon waters or in far away Australia or New Zealand.

However there are several very representative members of the clan to be met with at Karwar. These are:

The **Surmai** (*Scomberomorus commersonii*), Striped Seer fish, Spanish Mackerel; in Kanarese, *Esuvan*.

This is a streamlined tiger of the sea, a true speed-merchant and highflier, which it is an exhilaration to have at the business end of any moderately powered line.

It is a true mackerel in shape, like a somewhat laterally flattened torpedo, sides and head somewhat compressed, the snout coming to a sharp point, the jaws garnished with a goodly array of lancet shaped teeth, the glaring eyes full of the lust of speed and destruction. Villiform teeth are found on the palate. There are two dorsal fins, of which the second is the highest, being falcate and posteriorly concave. The pectorals are sickle shaped and pointed and lie straight above the very small ventrals.

The caudal region, laterally much flattened and attenuated, ends in a caudal fin shaped like a double sickle or a quarter moon. Between the caudal and the dorsal fins, as well as between the caudal and the anal, rows of about 10 finlets will be found.

The scales are minute and inconspicuous. In colouration the

fish is in the main silvery, shading to purplish and green tints along the back and the upper parts of the head. The greenish black stripes which embellish the sides are not conspicuous in life, but become so soon after death has set in.

This is a fierce and extremely predaceous fish, travelling in schools of a dozen to a hundred in pursuit of prey, which they follow with the tide sometimes into fairly shallow water, and not infrequently quite close inshore.

To watch them smashing up a shoal of travelling *bangra* is a real sight. Sometimes a dozen or more of these long white shapes skyrocket to heights of 12 or 15 feet and coming down head first with a resounding smack into the middle of their densely packed prey, smashing and stunning them, gobble them up at leisure. It is a truly amazing procedure.

The Surmai has none of the snagging propensity of the Bahmin. Most of its fight is generally near the surface. When at all large he will, *if allowed to*, produce a lightning run of up to 100 yards or over and frequently end this with a series of quite spectacular leaps. I have never seen this truly magnificent performance equalled by any mahseer I ever hooked. Size for size it is only surpassed by the Wahoo. In his tactics the Surmai resembles the mahseer, not only in the spectacular first run, but also in the cruising, which so often follows, and the rest of the performance seems rather tame after the truly exhilarating start.

Unfortunately the Surmai that approach to within the angler's reach seldom weigh much over 30 lbs., whereas in deep waters, such as those of Queensland, they surpass 6 ft. in length, and reach a weight of up to 150 lbs.

It is a delightful table fish, when not too large, worthy of the best effort of a good mackerel cook, and ought, by rights, to be washed down with a glass or two of some racy white wine.

Surmai visit Karwar at any time after the middle of October, whenever a sufficiency of their favourite food fish is present in the bay, rather than further outside, and they continue to do so well into the hot weather.

Their presence is soon betrayed by their leaping tactics and there ought not to be much blind fishing or trolling for them.

The Spotted Surma (*Scomberomorus guttatus*).

Much of the description of the Striped Surmai applies to this closely related species, except that it is often not quite so slenderly built as its relative, and is covered on the sides with a number of darkish spots. In general its dimensions are more modest.

It follows the same tactics as its striped cousin, and is an equally esteemed table fish, which may reach 3 ft. in length or over and weigh 20 lbs. or more.

They do not appear to visit Karwar as often as their cousins. Weight for weight they seem to be as good and nimble fighters as the preceding species.

The Horse Mackerels (*Caranx sp.*), *Koker*.

This is quite a large tribe comprising some very large species and some very small ones. They are all deep-set fish with large heads ending in somewhat blunt snouts, with the lower jaw

rather pronounced. They are armed with conical and also villiform teeth. Their bodies are well covered with very small scales, even the opercles getting their share of this protection.

There are the usual two dorsal fins of the mackerel tribe, and the pectorals are generally long and sharply falcate. The caudal region is strongly attenuated, and the posterior third of the lateral line provided with a series of hard armed plates.

In colour they are mostly silvery, frequently with a light golden sheen, and in some of the smaller species most of the fins are a very bright yellow. The caudal fin is a sharp double sickle. Two of the larger species at least are regular visitors to Karwar, i.e. *Caranx gallus* and *Caranx hippos* and there may be others.

One of them is known to local Mussulmans as *Sidibai*, the 'negro woman', on account of its thick lips.

They may run well over 60 lbs. and are then quite formidable opponents requiring a good deal of skill and judgement in being brought to gaff. However, those caught locally will not very often exceed 40 lbs. Even these give a very hard fight on moderate tackle.

Their tactics are not very spectacular, but as indicated by their shape, they are strong and speedy, certainly very tenacious and do not give in easily.

The first run of a *Caranx* is made at an almost incredible speed and invariably directed slantwise for the bottom.

It would be perfectly futile and quite fatal to one's line to try and interfere with the rush of a large *Caranx* in its initial stage. It far exceeds anything I have ever experienced from mahseer.

It is only in the later stages of the run that cautious application of the brake is permissible, if the fish is at all large.

It will then try various tactics and contest the efforts of the fisherman very bitterly and for quite a long time, keeping game to the end.

When gaffed and drawn inboard, many of them give vent to a pig-like grunt, whence their Indian name.

It is to be regretted that really large *Caranx* are by no means very frequent visitors to Karwar, whereas they seem to be present at the Malwan rocks and at the Vengurla lighthouse island during every monsoon and sometime after in goodly numbers.

Some of the smaller species are lively and gay little fish, frequently met with as they cruise about in small bands on the surf, often doing the porpoise act.

They are quite fierce predators and even half-pounders sometimes commit suicide by seizing a 3-inch spoon.

Small Caranx are quite excellent eating, specially the Yellow-finned variety, but the large ones are quite unfit for the table.

The Queenfish (*Chorinemus lysan*); locally: *Dagoli*.

This is a very fierce and game looking mackerel, with a curved and projecting lower jaw, a very widely cleft mouth, large and fierce eyes and a laterally very compressed body. The caudal fin is large and deeply lobed, and the pectoral and anal are falcate.

In life this fish is a beautiful silvery colour, shading into bluish towards the back. When dying a beautiful golden hue begins to

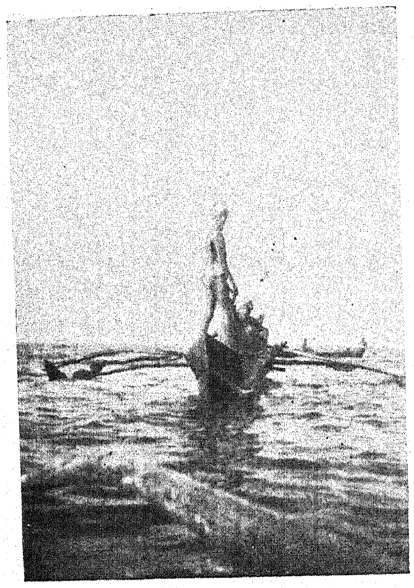


Fig. 1.—Outrigger canoe. Karwar.

Fig. 2.—Bahmin, Dagol and Surmai. Karwar.

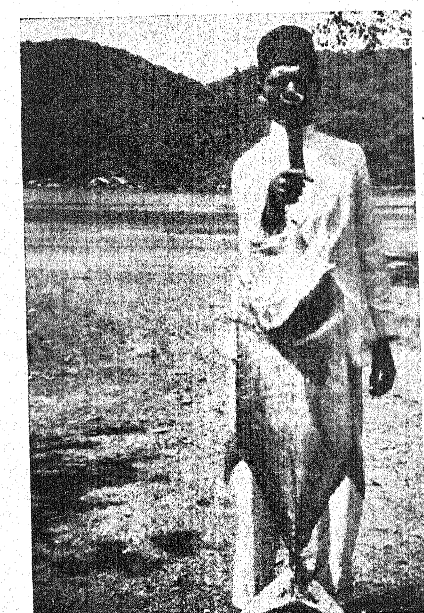


Fig. 3.—Caranx: 40 lbs. Karwar.

Fig. 4.—Red Rock Perch: 11 lbs. 'Toli' or Needle Fish: $7\frac{1}{2}$ lbs.

form all over the belly and sides. This golden colour intensifies gradually and persists quite a considerable time.

About five large round spots, the size of a crown piece are discernible along the lateral line. They are not very conspicuous during life but show up very prominently after death.

These spots are responsible for its Indian name.

There do not appear to be any very reliable data as to the maximum weight attained by this fish. It appears, however, to reach 50 lbs. round about Natal. At Karwar, a 35-pounder would be a very large one.

They are exceedingly fierce and predatory, and easily distinguished from the Surmai by their way of attacking a shoal of *bangra*, invariably from underneath, never attempting any 'smashing' tactics.

A successfully hooked Dagoli gives a glorious run on reasonable tackle, if not treated brutally, as is quite often the case with beginners. They are quite strong, and although not as tenacious as the *Caranx*, will not easily summit, and quite as often as not, will give several very decent runs.

A 35-pounder, foulhooked in the throat, once took 150 yards of 36 lb. line off my reel in an almost incredible run, at the end of which it jumped and thrashed about wildly on the surface.

I always considered it a privileged occasion to have a large Dagoli at the business end of a comparatively light line and a rather whippy little rod.

Although this fish is quite often caught on a spoon, my impression is that it really gives preference to bait, well and skilfully presented. I have also caught them in Ceylon waters from a motor launch, i.e. at Barbryn and at the Kalpitiya lagoon with Japanese feather squid.

The Queenfish, although very fond of the *bangra*, appears to relish even more a small, whitebait-like fish called locally *Buratty*, about 2 inches long, which sometimes visits the bay in large numbers, densely packed in little shoals. When these visit the place the Queenfish is sure to follow.

A somewhat smaller cousin of the Queenfish makes an occasional appearance and two or three of them took my spoon. This is very probably *Chorinemus toloo*. It does not seem to reach much over 18 inches in length, and is, therefore of no particular interest to the angler, but it is a much better table fish than its larger cousin the Dagoli whose flesh is soft and rather insipid.

The specimens of this smaller fish, I caught, appeared to me to be distinctly deeper, i.e. not so slender in a vertical sense, than the Queenfish. They were very white with a blue back, and had 6 small dark spots along the lateral line.

Chorinemus tala, which Day describes as bright orange with orange coloured fins, and which is said to reach 2 ft. in length, may also occasionally appear as it inhabits the same waters as the two preceding ones, but I never came across it.

The Black Kingfish (*Elacate nigra*); Morwasa.

An elongate and fusiform mackerel, laterally not so markedly compressed as its cousins already described. The mouth is wide

and the head rather broad and flattish, giving a somewhat murrel-like impression, quite unlike the head of any other mackerel.

It is armed with rows of villiform teeth and covered with minute scales. The two dorsal fins are of the typical mackerel type, the rear one, rather high and pointed, often emerges from the water when the fish is cruising. The caudal is large and crescent shaped, the lower lobe being the shorter. The pectorals are falcate and rather long.

The Elacate is dark olive in colouration, almost black in the upper parts and whitish along the belly.

It gives an impression of power and speed, which the large ones certainly do not belie.

In books of reference this fish is always figured by the picture of a very immature specimen, probably taken over from Day's book of *The Fishes of India.* This is quite unlike the adult and useless for the identification of a fully grown specimen.

The *Morwasa* or perhaps better *Mudhwasa* is a very worthy opponent, having besides, the special attraction of reaching a very considerable size. Specimens over 70 lbs. are by no means really rare. It does not appear to be as fiercely predaceous as the other mackerels, but puts up a good and stubborn fight initiated by a fast and long run. Really large ones streak off like lightning when struck, and give a great deal of trouble, before giving in.

They show no marked tendency to snagging one's line, even when caught in spots where they could easily accomplish this.

These fish seem to appear later in the season than most others and are one of the principal attractions to anglers operating in November and December.

Also they appear not to be so purely tidal in habit as other large mackerels, seeming to remain in the deeper parts of the bays, markedly so in Bingi bay, during any part of the day.

They are very often caught on set lines at night.

As a table fish the *Morwasa* has nothing to recommend it—being coarse and not tasty.

When they make an appearance in numbers in the bay, they do not seem to ever club together, but are met with singly.

The stretch of water from Badchidar point to Karkalli rocks and the water off the lovely little 'Ladies beach' or 'Reti bunder' are then good localities where a really large one may be trolled for. They are also occasionally hooked when fishing for Surmai or Rawas roundabout the islands, and I have come across them close in to Karkalli rocks, when the tide was very low.

Having thus exhausted the list of large and sporting members of the mackerel tribe, we now turn our attention to the other main family of fish, inhabiting these waters, namely the *Serranidae* or Sea Perches. The king of these, from the angler's point of view, is without any doubt that doughty warrior, known as:

The Cockup (*Lates calcarifer*). *Begti; Nair Fish, Kajoora.*

This is a powerfully built, high backed, perch, with the typical fin outfit of the tribe, the first dorsal being provided with thick

and pointed spines, pectorals and ventrals broad and somewhat blunt, while the great caudal, affixed to its very muscular tail, is broad and rounded. The posterior dorsal has only soft rays, whereas there are seven spines in the anterior. The mouth is very large, with a prominent lower jaw, and is well armed with villiform teeth on jaws and palate.

The scales are moderately large and the general colouration is greyish silvery, shading to dark greenish gray on the back.

This is a typical estuary fish frequenting the tidal waters of nearly every large river, and the waters outside the estuary.

They ascend tidal rivers right into sweet water quite frequently and may indeed be used for stocking freshwater lakes without apparent inconvenience to them.

This fish is one of the most esteemed table fish and of considerable economic importance in many parts.

It frequents Karwar Bay as well as the Estuary, but does not seem to be really numerous. For this reason it is caught by anglers, just occasionally by pure luck. Nobody has as yet taken the trouble to find out the habitual haunts, if any, it frequents by preference. A closer investigation of rocky spots in the river would be well worth undertaking with a view to discovering the feeding grounds of this fish.

Netters occasionally make a good haul of Begti of 30-40 lbs., as I once witnessed near Burkia rock, where I had trolled just a short while earlier, without having even experienced a touch.

The Begti has no predilection for a spoon, though it has quite often been caught on one. A dead bait cunningly presented to it, or better still a live bait such as a very large prawn or a lively mullet have proved much more killing.

Begti have been caught in the Kalinaddi along the large Casuarina plantation on the far side of the river just below Sadashivgad.

On another occasion I observed a very large one chasing small fish a few yards from shore at the 'ladies beach', but had, unfortunately, no casting tackle handy.

The Begti, in contradistinction to most sea and estuary fish of any size, seizes its bait not with a rush, but mouths it gently and must be struck, for which there is no necessity with any of the mackerel.

This fish may reach great weight, much over 100 lbs. under suitable conditions.

Anyone willing to go deeper into the habits and capture of this fish at Karwar will deserve the praise and gratitude of the angling fraternity.

The Gobras or Gropers, also known as Rock Cods are the giants of the family. Some of truly fantastic size have been caught in various tropical and semitropical seas.

In Queensland, specimens of 600 lbs. and more are not uncommon and are the nightmare of the trochus divers, who fear them far more than sharks. At Karwar the lighthouse keeper once landed one measuring more than 7 ft. length and 5 ft. in girth. It was covered with barnacles and a most fearsome monster. Its remains served as manure for the new coconut palms of the island.

During the monsoon netters have occasionally landed similar giants. When trolling deep in the channel between Devgad and Mothe islands towards evening using a *bangra* for bait, I have on two occasions hooked and played monsters of at least man size, but never succeeded in landing one.

The best known of these monsters is:

Serranus lanceolatus

A very thickset typical perch, very variable according to age and surroundings in colouration and markings. Young ones are often mottled brown on a gamboge ground. These colours dull with age. Adults are generally brownish above, shading into grayish below, and irregularly blotched over with reddish brown.

Serranus malabaricus and *Serranus salmoides*, which is probably synonymous with *Serranus diacanthus* also occur all along this coast.

They are, however, so similar to *S. lanceolatus* that they need not be given a special description in an article of this kind.

All these gobras are provided with enormous heads and huge gaping mouths, a set of conical teeth in the lower jaw and a large number of villiform teeth on jaws, vomer and palatines.

When gaffed they distend their opercles and inflate themselves, making their heads look quite leonine and menacing. The first dorsal has short and very stout spines, the second only soft rays. The pectorals, ventrals and anals are broad and blunt, often spotted, and the caudal is broad and rounded.

The paunchy body is covered with small scales.

These fish seem to be permanent or nearly permanent residents of these parts and not influenced by tidal conditions. They are great predators, but do not seem to chase their prey in the open sea like the mackerels. They apparently lurk in rock caverns and amongst boulders, to pounce on the passer by, whom they engulf in their cavernous jaws.

Owing to its purposeful skill in snagging one's line in a short lightning rush to the nearest rock, the gobra is a most detestable fish to hook. Having effected this first manoeuvre it quietly sits down behind its rock like a goonch, and earnestly applies itself to the severance of your line, in which it is much assisted by the presence of sundry mussels, burnacles and clams, with which the rocks are well covered.

The novice, not up to the wiles of his opponent, and finding his line whizzing out with the speed of the boat, not infrequently thinks he is fast in a running fish, and wonders at the endless run he is experiencing. 'Old hands' invariably recognize a gobra by its first and immediate reaction to the strike. The thing they do is to stop the boat and take it as nearly as possible right over the anchorage of the wily fish, circling slowly round, tugging all the while. This generally succeeds in dislodging the fish, which then tries to reach another nearby refuge.

By repeating this procedure as often as required even quite large gobras may be circumvented, provided the line holds, which is by no means invariably the case.

At all events the usual gobra of 30 lbs. or under ought to be landed, as fish of this size can be pretty roughly handled without actual risk of breakage, provided one's line is not frayed and one's rod tip plays up well.

Small gobras are quite good eating, and have appeared on many a Bombay man's table under the name of 'ishtone fish, suh.'! Chinese connoisseurs esteem them greatly.

A few small members of the gobra family inhabit the locality and will be mentioned when treating of the activities of the bottom fisher whose main catch they usually provide.

On the other hand several members of the allied family of the *Lutianidae* or Rock Perches, will quite often take an interest in a trolled spoon or bait.

They are sturdily built and often splendidly coloured perches, and frequently of very reasonable size. Indeed several of the fraternity may reach and exceed 30 lbs.

As indicated by their thickset, highbacked bodies, and determined mien, these fish are powerful and stubborn fighters for their size, ever ready to snag and cut one's line. They should, therefore, be handled with great firmness and circumspection if disaster is to be avoided.

Their relative strength has frankly astonished me on more than one occasion. Size for size, our friend the mahseer is simply not in it.

These *Lutianidae* are very much fiercer in their resistance.

The main members of the family commonly met with at Karwar are the following:—

The Red Rock Perch (*Lutianus roseus*); Tambosia.

This is a truly resplendent fish, clad in fair sized scales of auroral or rosy pink hues, with deep scarlet reflexes in the darker parts. In general shape it is much more elegant than a gobra, although somewhat thickset and humpy. The fins are also more elongate and of a more pleasing shape. The head is large, as is the mouth, which is armed with a few very respectable conical teeth.

This fish does not frequently exceed 7-8 lbs. at Karwar, but much heavier ones have been landed. It is astonishingly strong, and at first leads one to believe that something much larger has been hooked. The sight of its brightly pink body suddenly emerging out of the blue depth is quite a surprising apparition.

Like its fellow Rock Perches, the Red Perch is a great hand at snagging.

These fish sometimes invade the bay in vast numbers and then stay on for many days, during which they are met with wherever there are rocks to suit their fancy.

It is firm fleshed, perhaps a little coarse, but pleasantly full flavoured and very nice in a 'mouli', or as one item of a 'bouillabaisse', that most unforgettable French fish soup.

The Blue-spotted Rock Perch (*Lutianus argentimaculatus*) Kadori.

This is a very sturdy, powerfully built rock perch, reaching

well over 30 lbs., according to the literature. The heaviest I weighed was 27 lbs.

Although not so gorgeous as *L. roseus*, it is a very pleasing sight fresh out of the water, with its greyish, silvery ground colour, shading to darker hues in the upper parts, and ornamented as it is with several not too clearly defined vertical blackish bands and innumerable small, caerulean spots.

This fish is certainly expert at snagging, and applies its enormous strength very determinedly. Many are the lines that it has broken in a super-lightning whizz round a well barnacled rock. *L. argentimaculatus* seems to be more of a free lance than *L. roseus*, and does not seem to associate in large bands, and seems to be happy in little bays where a certain amount of surf keeps beating on the rock face. From the culinary point of view it is a most desirable catch.

The kalasis of the lighthouse are great hands at fishing for them, but lose many more than they land on their handlines.

The Tamboos (*Lutianus* spp.)

Lutianus johnii also a sturdy fish, but less highbacked than the preceding ones. It is more sober in hue, being generally olive brown in the upper parts and yellowish in the lower with purplish and golden flushes, and a prominent black spot in the rear part of the lateral line. It frequently ascends tidal rivers and is said to reach up to 5 ft. length. The heaviest I weighed was just under 30 lbs., 15 lbs. is a common weight at Karwar. These are quite fierce fighters and amazingly strong when of good size.

Lutianus sillaoo.

Brownish red in the upper parts and often vinous, but a fine deep lake below the lateral line. On the throat and chest it may have scarlet reflexes and orange on the opercles.

This fish is also said to grow very large and is frequently found a long way from the sea up tidal rivers.

It is excellent eating and greatly esteemed by the population.

I have never had the good fortune to hook a large one, but judging by the resistance put up by the 3-5 pounders I handled I must have missed something worth experiencing.

[**Lutianus fulviflamma.** This member of the family may or may not be ornamental with a black spot above the lateral line. It is frequently vinous red in the upper parts with pink flashes, and the lower parts have a beautiful golden sheen. This beautiful fish does not appear to visit the bay very frequently, but I have occasionally caught it at the south-western end of Mothe island, when it gave a most excellent fight. The largest weighed 17 lbs. and was very good eating. They took a spoon quite readily.

The genus *Sciaena* is represented mainly by :—

The Gol fish (*Sciaena sina*)

This is a very familiar fish to the inhabitants of Bombay, who frequently see them carried about on the heads of nimble little Koli women. It is a fine representative of the *Percidae*, rather more slender and elongated than those treated previously.

The body is covered with moderately large scales, brownish in the upper parts, greyish white below.

These fish reach 50 lbs. and over and appear sometime in September in vast congregations in the bay. They are easily spotted by their habit of lying up closely packed, almost at the surface, forming a large purplish patch.

Several boats then sally forth with long nets in which they encircle the shoal of fish, gradually tightening the circle, until they have them in a bag between two boats.

The catch, which frequently amounts to over 600 fish in one haul, is taken ashore, cleaned, gutted, salted and sun dried on rocks.

The finished product used to be bought up by Moormen from Colombo at amazingly low rates for disposal to the plantation labourers in Ceylon, as a welcome addition to their diet. These merchants were, however, so grasping, that in certain years the local fishermen stood firm and refused to fish for gol.

The Gol, a fast and tenacious fighter, is caught on rod and line only as a piece of very occasional luck.

It is rather coarse but quite tasty.

Having reviewed the main members of the two great families of the *Scombridae* and *Serranidae*, and treated that superb game fish the Bahmin, we now have to say a few words about the local representatives of a few other less prolific families, with which the angler may come into contact.

The local representative of the *Sphyraenidae* is:—

The Barracooda (*Sphyraena jello*); Banasia.

This is a true sea pike, bearing a fair resemblance to our freshwater pike, with whom it shares the spare and elongated body and the very predatory mouth full of pointed teeth. In many areas of its extensive range this fish reaches a length of 6 ft. and a weight of 60 lbs. and over. It has a bad reputation for ferocity and is greatly feared by bathers in some parts.

In Karwar, they are occasional visitors never reaching anything like full size. Amongst the many I caught, the largest did not exceed 16 lbs. and was a mere baby compared with some I came across in Ceylon and Australia.

These small barracooda are after all mere undesirables. They come in like lambs, are in the habit of vomiting up the contents of their stomachs in the boat, and as table fish they are detestable.

A large one, no doubt, does put up a much better show, but size for size cannot compare with surmai or dagoli.

The local member of the *Scombresocidae* of interest to the angler is

The Garfish (*Belone annulata*) Toli.

This is an extremely elongated and very slender fish with a very long and thin snout, like a gavial, full of needle pointed green teeth. The dorsal and anal fins are situated very far back, in fact just before the tail. The pectoral and ventral fins are very small as are also the scales.

The colouration is rather bright, the back being sea green and

steel blue, the sides pale greenish shading down to white, and the lower jaw frequently black.

The Gar is chiefly remarkable on account of its long jumping performances. It will suddenly shoot out of the water, like an arrow from a bow, to a height of about 5 ft. and a distance of 20 to 30 ft., and repeat this several times, just barely touching the water between leaps.

The local representatives, rarely much over 2 ft. long, will occasionally take a spoon, but much prefer a dead bait rapidly drawn over the surface. This is in fact how much larger specimens of the genus are circumvented in the Seychelles, where a flying fish is trolled from a motor boat.

As a table fish it is not to be despised.

The only member of the great herring tribe of any interest to the angler at Karwar is

The Wolf Herring (*Chirocentrus dorab*) Karli

The fish reaches colossal dimensions in the Pacific, where it is credited with a length of 12 ft. It never seems to exceed 4 ft. in our waters.

A very elongated and laterally very compressed fish, with an underhung jaw and a mouth full of very pointed and sabre shaped teeth. All fins, with the exception of the caudal and the anal, are very small, and the dorsal is situated very far back. The scales are small. The caudal fin is deeply forked.

The colouration is quite striking, being bright silvery with a beautiful ultramarine blue along the back.

This very predatory fish appears often in numbers of mostly undersized individuals. They are then almost equal in nuisance value to the abominable scabbard fish, mauling and tearing up one trolled dead bait after another, making fishing in waters which they infest almost impossible.

However, when the larger ones come, they may be observed swirling on the surface and even leaping as they feed on sardines. Then is the time to rig up one's little tubular steel rod and level winding reel and to cast them a little plug or a cunningly mounted dead bait. Quite pretty play, with a few acrobatics thrown in, will ensue and furnish the delighted angler with a welcome change from the eternal trolling.

The fish is unfortunately full of sharp little bones, but otherwise quite tasty.

Strips of its tough and white hide make quite good trolling baits, the entire fish is one of the most favoured baits used in Ceylon by swordfish anglers.

Finally I might yet say that I have ample evidence of the presence, some 15 to 20 miles further out, of such very desirable members of the mackerel family as the dolphin, the bonito, the yellow-fin tunny, the wonderful sail fish and the marlin, which are at present quite entirely out of reach. Perhaps the day may come. . . . ?

It is now necessary to give a short list of the fish to be procured by such methods as *drift lining* and *bottom fishing*.

The first mentioned method, i.e. drift lining or *surf lining*

from an anchored boat, will quite often procure quite interesting results. This form of fishing is not often indulged in by visitors to Karwar, as it is most fruitful in channels with a rapid tidal flow towards and after sunset, such as the passages between Badchidar Point and Elephant (Mogeragudda) island, the one between Devgad and Mothe, and the channel between Kurmugad and Badlingad.

Apart from various rock perches, such as *Lutianus roseus* and *argentimaculatus*, caught on medium-powered driftlines baited with chunks of *bangra*, with now and then a *gobra* thrown in, we caught on light lines floated in the surf of small indentations, the pretty *Diagramma crassispinum*, and in the tidal current *Hemiramphus limbatus* both of which take a prawn's tail well enough.

On large chunks of *bangra*, very large rays and an occasional dogfish may be caught.

On occasions the fun was interfered with by incursions of the very detestable *Trichiurus malabaricus*, the Scabbard fish, which drove everything else away, and one had to pack up and leave the place.

Of the fish mentioned above,

Diagramma crassispinum, locally called *Amboi*, is one of the most interesting on account of its qualities as a table fish. It belongs to a separate genus of the *Serranidae* or *Sea Perches* and is a sturdy and deep set fish in a pigeon grey uniform of small scales. Its main characteristics are the very stout spines in the first dorsal, and a particularly thick one in the anal, and above all the very thick and fleshy lips, which in Queensland have earned it the name of 'Sweet lips'.

It may exceed 20 lbs. but most of those caught by drift lining are quite small.

Hemiramphus limbatus is one of a number of very curious garfish like *Scombresocidae*, characterized by a much produced lower jaw, forming a kind of beak. The body is slender and sub-cylindric in section, clad in scales of moderate size, coloured greenish with blue sheen above, shading down to white below.

In contradistinction to the lower jaw, the upper is very small. The dorsal fin is single and stands opposed to the anal in the posterior part of the body.

These fish do not exceed a foot in length and often appear in large numbers, when they are eagerly sought after owing to their excellent culinary qualities.

When they are on the feed the fun is fast and furious and they can be taken in rapid succession, cast after cast.

Trichiurus malabaricus and its relation to *Trichiurus savala* belong to a separate family, the *Trichiuridae* or Scabbard fish. They are aptly described by their local Marathi name '*Bale*' the spear. Their characteristics are a very slender, laterally compressed, elongated body, with the dorsal fin running nearly the whole length of it. There is no caudal fin, but the body ends in a sort of thin rat tail. The ventrals are practically reduced to nil and the pectorals very

small. The muzzle is elongate and the mouth very wide and furnished with a goodly array of pointed teeth.

These fish are apt to appear now and again in considerable numbers, when they are a frightful and abominable nuisance, destroying and maiming little fish literally in thousands, i.e. far more than they could ever devour, evidently in sheer bloodlust.

At times I have seen the inner harbour of Karwar full of swarms of small mackerel (*Toki*) everyone of which was more or less gashed or mutilated by these pests, and in an evident state of helpless terror. It was quite a pitiful sight indeed.

Trichiurus is a great nuisance to the troller using a bait fish, as they slash these up time after time and render them useless.

It is most inadvisable to sally forth after sunset in a canoe, wearing a white shirt or singlet, numbers of *Trichiurus* are then about and they are quite likely to leap at a white arm or shoulder, inflicting a painful bite. My tindal Genoba experienced this much to his discomfiture in my presence, when such an attack left him bleeding profusely and very sorry for himself. *Trichiurus* is eaten but not greatly esteemed.

The ray most commonly caught by drift lining is the Leonard ray probably **Pteroplatea micrurae** a large ray with a somewhat rounded disc, white below and covered above with dark and light spots and blotches. It has a long whip-like tail furnished at the base with one or more, flat dagger-like spines, up to 8 inches long, with a finely serrated edge, with which it inflicts very painful and dangerous wounds.

They are rather fun to catch, as they make off rather slowly but with great power and determination and take quite a bit of hauling before they can be brought alongside. It is a queer sight to see these great flat things emerge from the depth into the starlight, belly up and looking just like a white blanket.

We caught them up to 70 lbs. and over. They are cut up and sundried in strips, and are said to make quite a palatable stew.

Fish caught by bottom fishing.—This is mostly done from an anchored boat, in spots well known to the boatmen, who often practise it. It is most successful at sunset and after, and is mostly performed with handlines, baited with prawns or chunks of fish.

The main bag is composed of whatever small or medium sized gobras may be about.

At times some of the *Lutianidae* will appear in numbers, and form part of the haul. *Diagramma crassispinum*, the Amboi, is often caught, as are one or two members of the *Sciaena* family.

Other, but very unwelcome familiars are the various murrain eels, hideous creatures which tie themselves round the line in a slimy ball and inflict a very painful bite, unless care is taken. They are extremely pugnacious.

A short description of the following will suffice. Amongst the minor gobras we meet:

Serranus fuscoguttatus, covered with rusty yellow spots.

Serranus undulosus with a number of dark longitudinal lines along the sides.

Serranus commersonii, a lively little fellow with longitudinal black line above the lateral line, much fished for by boys along the quays.

A very much better fish is that very good eating perch known as The Palu. This is a thickset pearly grey fish, with sturdy spines in dorsal and anal fin, running to 3-4 lbs. It is much esteemed as a table fish and has the reputation of being the champion bait-thief on the West Coast.

It is found in fair numbers also in tidal rivers and in estuaries.

One of the *Chrysophrys*, a pretty little fish resembling the Palu, but more whitish and having bright yellow pectorals, perhaps *Ch. datnia*, is also not infrequently caught.

By far the most welcome catches are the *Lutianidae*, chiefly *Lutianus roseus* and *L. argentimaculatus*, which have already been described. Amongst the eels the following are common:

Muraena tessellata, a flattish eel with a large head, beautifully marked with black spots separated by narrow white lines.

Muraena tile, with a yellowish ground colour forming reticulations between numerous dark blotches.

Muraena undulata. Marked with numberless little brownish spots and blotches on a pale ground, and there are probably others.

Fishing

Having described the locality and the fish available it is now necessary to give a few hints as to the best spots where fish resort and the best methods to circumvent them. These hints will be found useful by the novice and may save even the expert some time and disappointment.

Fishing seasons. It has already been hinted that fishing at Karwar depends to a very great extent on the presence of swarms of migrating fish, such as certain *Engraulis*, *Clupea* and small mackerels, chiefly *Scomber microlepidotus*, the Bangra. Shoals of these migrants travel along the coast from September well into the hot weather in one direction or the other, and when they hug the coast closely, as they often do, they not only provide the population with food, but attract all the larger predatory fishes, which otherwise keep far outside.

Signs of the presence of these larger fish are then quite unmistakable. The disturbance caused by their attacks on the shoals, results in spasmodic leaping which sends the spray flying.

Or great and gleaming white fish will be seen leaping high into the air. Fishing is then more or less at sight, and may be possible all over the bay and the adjoining inlets, wherever these signs are reported from.

During the time preceding the arrival of the shoals of small fish, i.e. in the second half of August and early September, when the main run of Bahmin and large Caranx generally takes place, fishing is almost entirely confined to the waters in close proximity to the various rocks and islands, and to the channels between

them. The fish visit these feeding grounds regularly, coming in and going out with the tide.

For this reason, and according to general experience the best times for fishing roundabout the islands are:

(1) From the end of the first quarter of the incoming tide to the beginning of the third quarter.

(2) From the beginning of the second quarter of the outgoing tide to some time past the half tide.

This rule is of course not absolute, as stragglers often visit the rocks at the high tide or at the extreme low one.

However, most of the fish, at high tide, scatter inside the bay, where they are difficult to find, while at low tide they, as a rule, prefer to retire further out to sea, as is but natural and logical in such a shallow coastal region.

Sometimes, when the fish have left the islands of the lighthouse group at the approaching high tide, they may be met with again near Kurmugad and Madlingad islands, which lie nearer to the estuary.

I have more than once experienced this. During the Bahmin season attention should be paid to the sporadic appearance of shoals of small cuttlefish, which form one of their favourite foods and which they pursue in open waters. An angler's dream!

Swarms of minute, whitebait-like creatures also appear at times and are inevitably followed by the very desirable Dagoli, which is quite inordinately fond of them. Local fishermen call these small fish 'Buratti'.

Methods of fishing. As for the methods of fishing, by far the most successful is that rather tiresome process-trolling, so little relished by the fresh water angler, and which in less lively times means little more than a blind quartering of the area and utter boredom. Relief may come from the occasional sight of a family of otters gambolling in a little bay, or by such diversions as the appearance of a school of porpoises or false killers, or by the swoop of a sea eagle on an unsuspecting sea snake. There should, however, not be too many such days.

Where to fish. During the Bahmin and Caranx season the search for fish should be narrowed down to the rocks and islands, commencing with the isolated rock called 'Burkia' where Caranx are often encountered.

Then proceed to the Karkalli rocks and keep your eyes skinned for swirls or leaps round about both ends, and also along both faces, particularly in the shallow bay on the seaward side, where there is often a pretty little turmoil of surf. Troll as close in to the rocks as you dare or as conditions permit, and you may be rewarded by a strike.

If this proves barren, then visit the single rocky pyramid a bit further towards little Devgad, the water between this and the flat stone table island on the far side.

Immediately to the west of the pyramid is a small area of shallows, formed by sunken rock, where usually a good deal of surf obtains. This is frequently a sure find for Bahmin, but exceedingly snaggy. Proceed then to the channel separating the rock-table from little Devgad island, it often holds a fish,

The water on both main sides of little Devgad is almost never tenanted by anything else than gobra and may be given a miss.

Proceed then to the south-eastern end of Mothe island, at the entrance of the channel. If a surf plays at this spot it is tenanted just as often as not. Then proceed up the channel along Mothe Island. Mark the spots where the surf is liveliest and give them the once or twice over. This island face is one of the favourite feeding grounds of the Bahmin. The northern end holds them rarely, but has provided some very fine Caranx, and is often visited by sharks.

The western or south-western face of Mothe holds, just past the south-eastern end, a rocky shallow bay where I have had at times great sport with smallish and very lively Bahmin.

The face of Devgad island, opposing Mothe, is not a favourite with Bahmin, but is visited by huge Gobras, and a little indentation in it with a good deal of surf is a favourite spot for *Lutianus argentimaculatus* of good size.

The north-western end of Devgad is formed by a slanting rock-table in front of a high rock wall. There is generally a strong surf there washing far up the flat rocks. Here some of the really large Bahmin, the 25 Pounders, etc., have been caught. This spot is followed by a roomy and deeply indented bay forming a great part of the north-west side of Devgad island. It is rather shallow, but occasionally tenanted by smaller Bahmin. At the far end is an outlying single rock, between which and the island there is a rather shallow passage where the turmoil of waves is often so savage, as to render it quite impassable. This passage is a favourite spot, as are the rocks beyond it, which form the north-east end of the island. However, a tremendous surf break so often over these rocks in August and September, that often they are not as approachable as one would like them to be.

At the eastern face, just past these rocks, we find a bay in which is situated the island's well, surrounded by a few coconut palms.

This bay is a good find for Gobra, *Lutianus argentimaculatus*, and the face of the island, from this bay up to the entrance to the channel separating it from Little Devgad, is very often a good place for Bahmin.

The channel separating Kurmugad from Madlingad and the small rocky islet at the north eastern of Kurmagad are often tenanted by bahmin, but hardly ever big ones, especially later in the season, i.e. early in October or late in September.

Trolling. When trolling in such localities, i.e. close to a rock-face and over fairly shallow water with a bouldery bottom, a short line of some 20 yards is mostly ample, and really an advantage. A fish can more easily be controlled on short line than on a long one. In more open water, 30 yards of line out should be considered normal. On calm days and very clear water an additional 5-10 yards may be given in the open. It is convenient to mark these lengths on the line with a whipping of coloured silk.

It is a good plan with all lines to be used in trolling in snaggy places to double them at the business end over a length of a few yards, and to affix an inch of whipping at intervals of about 2 ft. Quite often one part of the doubled line may be trayed by contact with a rock when fighting a fish, and the situation yet saved by the other. This is permitted by the rules of most sea fishing clubs and should not be neglected.

With the slow motion oval spoon generally in use, or with dead bait, anti-kink device is not rigorously essential.

With hogbacked spoon and some of the so-called self-striking spoons, which have a rapid motion, it is, however, quite essential to use a good anti-kinker in the interest of an expensive line.

A boat-shaped trolling lead may be used when it is desired to troll deeper than the usual 3-4 ft. This is a useful plan when trolling for gobra or rock-perch. Leads of 3-4 oz. will be sufficient. When trolling with an 8 oz. lead and a large chunk of fish south of Mothe island I once hooked an enormous fiddle ray (*Rhynchobatus*) and played it for quite a while. Ultimately I lost it, not altogether to my regret as it was far too large to ship in a canoe.

The face of Karwar head up to Badchidar point may be neglected from the trolling point of view until the end of October, after which the deep part just off the Ladies' bay often is tenanted by *morwasa*, which also seem to like the space between Badchidar point and Burkia rock. In both these stretches a lead sinker may be used.

The channel between Badchidar point and Elephant island (Dukri) is often a hunting ground of dagoli and surmai and may be trolled for them. Elephant island often attracts fairly large gobra, and the rocks off its western or south-western side are occasionally visited by bahmin, as is the seaward side of Anjediv island, especially the south-eastern end, where very often surmai will waylay a shoal of bangra. Anjediv is, however, far afield for a canoe based on Karwar, but canoes may be hired at Bingi village.

Bait-casting tactics with a good surf casting outfit, or even a stout mahseer outfit, provides very enjoyable and quite exciting sport whenever bahmin are found to be feeding in the estuary. Suitable spots are just behind the bar, alongside an extensive Kasuarina plantation, just below the fort hill of Sadasnivgad, on the far side of the Kalinadi.

The fish will be noticed swirling and leaping, often within a few yards off-shore, and the water is almost entirely free of snags there, except for a few stumps closer inshore.

These bahmin are frequently quite ravenous and just take anything cast to them:—spoon, plug or deadbait, with the greatest alacrity. The first rush of a good one, aided by the tide-rip is truly magnificent and may be fully allowed in this snagfree stretch.

Most of these bahmin, although very rarely large, fight wonderfully well, and frequently in their fury beach themselves by running on to the sands, where they leap and flounder about until grappled by an attendant. This is highly necessary as they

often rid themselves of the hook and disappear with a leap into the briny.

Opportunity for this glorious fun occurs at intervals during September-October, but it is as a rule confined to the last quarter of the low tide and so never lasts long.

It is therefore advisable to brief a watcher on the spot, preferably one possessed of a cycle or furnished with one, to bring immediate *khubber* when a shoal of bahmin has entered the estuary. The fish frequently enter the estuary at night and may then be fished for at the next low tide. I have never known them to be on the spot more than 3-4 days in succession after which they may be absent for a week or so.

True surf casting is the method least tried at Karwar, where the waves break too far out on most beaches to allow of it.

It might prove successful at the Cemetery bay, at and near full-tide. Sport with rays and dogfish is quite on the cards there, and I shall certainly give it a try at my next visit. At nearly every other spot the slope is so gradual that it would be useless to try.

A few more purely technical hints about actual fishing may be helpful and therefore follow.

With most of these seafish a strike is unmistakable and not unfrequently produces a jerk, which almost tears the rod out of one's hand. Should the strike materialize anywhere in the immediate vicinity or rocks, as it mostly does in Bahmin fishing, and no immediate ocular demonstration follow, as is produced by such surface fighters as surmai, dagoli, or morwasa, a very firm hold should be kept on the line by means of any braking device provided on one's reel. The line should be allowed to slip out by inches only, while the boat is pulled into open water. The time needed by a good crew is not more than a few seconds. Nevertheless it would be fatal to stop the line altogether. The fish are extraordinarily powerful, and the process of dragging a fairly large body out, often against a strong current, develops a considerable strain, which might easily cause disaster to rod or line.

When playing a fish, except one of the surface fighters mentioned, it is advisable at all times during the fight to keep a really tight line without however being brutal.

This is first of all rendered necessary by the ever present tendency of gobra, bahmin and *Caranx* to snag one's line on the nearest rocks, and secondly because of the poor hookhold offered by most parts of a bahmin's mouth. Quite often no real hold is effected and the fish can only be played by constant tension. It will drop off the hook as soon as it is gaffed, and the tension ceases.

Very frequently a surface fighter is hooked near rocks. When this is unmistakably the case, the fish may be allowed its run from the very start, as neither dagol, nor surmai or morwasa are likely to snag one's line intentionally. They make straight for the open water.

Such fish should never be held hard, but kept running on a moderately tight line only. A hard hold would deprive the fisher-

man of the possible thrill of a lightninglike rush of 100 yards or over. Only then, a tighter hold may be applied, and the fish struck. When dealing with bahmin it is advisable to strike at the end of the first run, to increase the chances of a good hookhold. With surmai and dagoli the necessity is debatable.

Runs of the length stated above are never put up by even the largest bahmin. They confine themselves to moderate runs at great speed, invariably in the direction of the nearest rocks. These rushes are generally followed by a series of very strong tugs and sometimes leaps, after which the usual cruising and circling will follow, until the fish can be drawn in to gaff. Watch the fish warily at this stage as the possibility of a sudden dive for a rock is always present, or it may suddenly rush straight at the boat in an attempt to pass underneath. This must be foiled by all the available tactics of rod and boat, as it would inevitably end in a smash up.

An experienced angler will immediately recognize a gobra by its short superspeed dive for the rocks close at hand. It is short, swift and quite unmistakable. The tactics given earlier under the description of the fish should then be applied.

A slantwise rush to the bottom at incredible speed and often over 60 yards or so, indicates a large *Caranx*. The strength of these fish as developed in this first rush is so incredible that it would be the height of folly to do anything except prevent an overrun. A gradual increase of resistance is not permissible until the speed of the run shows some slowing down.

In the pursuit of surmai or dagoli, in the act of smashing up shoals of food fish, use dead bait, as then they hardly ever consider a spoon.

The best tactics are to let out a very long line, and to have one's boat rowed round the shoal, without approaching it too closely. Then, at the opportune moment, draw the bait through by rapid reeling in. To approach closely or to take the boat through the shoal would be quite fatal to one's purpose.

Casting. If the fisherman, possessing a good stout casting rod and reel, can rig it up in time, the sight of surmai smashing up bangra provides the most glorious sport. Cast across the shoal with a long cast and pull through. Repeat if nothing has happened.

A good caster will be able to enjoy incomparable sport with surmai or dagoli, when they are in action in numbers.

An experienced caster, provided with stout tackle, also may enjoy very good fun in casting for bahmin towards the rocks from his boat, but he will lose many fish and some tackle too. The fish are so swift in effecting a snag.

It is because of these tactics of the bahmin that casting from rocks is practically useless, unless the fish is yanked out at once by main force. This no true fisherman would think of doing.

A few words about drift-lining and bottom-fishing follow.

Drift-lining answers best at sunset and after, in places with a good deal of tidal current, such as channels between islands.

According to what one intends catching, light or heavy lines are used, the quantity of load weight used depends on the

force of the current. The baited line is flung out across the direction of the current. More and more line is paid out and subsequently retrieved, to cover as much water as possible. A trace is as often as not dispensed with. When there is little current a float may be used.

Generally rod and reel are dispensed with and hand-lining resorted to, which is enjoyable for a change. It gives one a 'feel' of what is going on, which one never gets with rod and reel.

For bait, prawns' tails or crab are excellent for small fish, and chunks of bangra or large strips out of the side of a fish will do for the larger ones. Small squids are excellent bait.

A variety of this sport, which I would call *surf-lining*, may be successfully practised at many points along the Karwar head. It can be done wherever a small rocky bay or mere indentation in the rockwall shows a lively bit of turmoil and surf, which does not allow an unweighted line to sink to the bottom.

The boat is anchored about 10 yards outside and the baited line flung in. The motion of the water with its currents and counter current causes one's bait to search out the whole place. Quite often very good fishing results, unless the inopportune arrival of the abominable *Trichiurus* puts a stop to the proceedings, or 'phosphors' show up one's line too prominently.

When drift-lining for *Hemihamprus* a fairly large corkfloat is used, to which several short lengths of line, provided with hooks are attached. The device is baited with prawn and flung out, attached to a thin line, which is paid out as required. When the *Hemirampi* are really on the feed, the fun is fast and furious, as frequently 2-3 fish will be hauled in at one cast.

When hauling in a skate or ray, care should be taken that the spines are chopped off before the fish is taken inboard. They are highly dangerous. On a starlit night this form of fishing is quite enjoyable and provides a nice change.

Bottom-fishing is the method mostly resorted to by local sportsmen when they are not netting. It is at times quite interesting and like driftlining it is most productive of results after dark. Groundbaiting with chopped up fish is a necessary preliminary.

If there is no current, the fish bait may be simply thrown in. Wherever there is a current it is advisable to confine the bait in the meshes of an old bit of net and to lower this with the help of a stone by means of a rope. The depth is then plumbed and one's lines lowered to a length, which keeps the baited hook about 2 ft. from the bottom. This precaution avoids a good deal of snagging and loss of tackle.

When baiting with loose chopped fish, or 'chumming' as the Americans call it, a handful of bait should be dropped in every ten minutes or so. This is quite often also done in drift-lining.

Bottom-fishing may at times result in quite amazing catches. I shall always remember an occasion when my wife hauled up in some 2 hours, 50 Red Rock Perch. Most of those in process of being hauled up were shepherded by 2 or 3 'unattached' friends, and it was a truly amazing sight. She might have caught another fifty quite easily as they seemed inexhaustible.

Quite large gobra are frequently caught when bottom-fishing and the kadori, (*Lutianus argentimaculatus*) at the end of a hand-line, provides quite exciting sport, if of decent size. It is advisable to wear gloves when indulging in this pastime to save one's hands from being cut by the line.

The boatmen are quite conversant from personal experience with the best spots for bottom-fishing and surf-lining, and are generally only too pleased to take a hand in the sport, and to help increasing the bag.

As to the most favourable time of the day for fishing in the bay, this is a question often debated amongst visitors.

Personally, I believe that it has in general little to do with one's chances, as these depend on the presence of fish, and that again, as explained before, is a matter of the state of the tide, and of the presence of food fish.

I must, however, admit that I have more than once been lucky with good *Caranx* at Burkia rock at the crack of dawn, seemingly irrespective of the state of the tide.

TACKLE.

It is a home truth equally valid for the expert freshwater fisherman as for the sea angler, that the possession and handling of really first class tackle is a joy in itself, and that such fine tools go a long way to ensure enjoyment and successful fishing.

Such things are however expensive and really not worth investing in when it is a case of just augmenting a casual holiday by the seaside with a little indulgence in sea fishing.

This happens to be very frequently the case with visitors to Karwar, who often have no previous fishing experience at all.

In a few notes placed years ago at the disposal of the Army and Navy Stores for their catalogue, I recommended for the use of such casual and inexperienced visitors simple yet seemingly excessively strong tackle. However extreme these recommendations may appear to the expert fisherman, they have fulfilled their purpose for many a novice, whom they helped in getting a first experience in seafishing, without the disappointment of losing nearly every fish hooked.

However, as these present lines are addressed more to the man with some experience of fishing in fresh or salt water, I shape my recommendations as follows:—

There is scope in Karwar fishing for medium and for fairly light sea tackle. This, in the hands of a practised fisherman, should suffice to deal with anything he will come across, except a giant gobra or a shark, if he has the misfortune to be taken on by any of these. These possibilities, though undoubtedly present, are sufficiently remote to be left out of consideration.

It will have been seen that much of the local fishing is of a very specialized nature, owing to conditions of fairly shallow water and bouldery bottom, which necessitates holding tactics not needed elsewhere in the pursuit of the same fish. These circum-

stances impel the use of stronger tackle than would be required if the weight of the fish was the only criterion.

To these considerations full attention has been paid, and they should be accepted and considered in this light.

As the result of many seasons' experience I have no hesitation in recommending the following :—

Trolling outfit for casual visitors.—A fairly whippy 7 ft. sea rod after the style of Manton's 'Blair' Sea Rod. A simple reel, such as a 5-inch or a 6-inch wooden Nottingham reel brakeable by gloved hand, or by a lever arrangement. Traces, lines, lures and gaff as for the expert.

Trolling outfit for the expert.—If cheapness is essential, the above recommendation may be considered. If this is not essential then I would recommend one of those very delightful split cane rods such as Hardy's Saltwater Rod No. 2, or an equivalent in greenheart. Such a rod should have a maximum length of 6-7 ft. and should be relatively whippy.

The above-mentioned style of rod is built after the American idea of a short butt and a long one-piece tip. The latter item, ensuring a beautiful whippy action, is very pleasant in use.

The total weight of such a rod is not more than 21 oz. for the tip, 14 oz. for the butt and it is consequently delightful to handle.

These rods are constructed for use either with the old style reel set under the rod, or with the American reel used over the rod.

For a reel to be used under the rod, I unhesitatingly suggest one after the style of Hardy's sea silex, i.e. a reel provided with one or two good checks and brake lever operating by friction pad on the axle. It should be made of non-corrosive metal.

The Army and Navy Stores used to have a very serviceable reel made of walnut and brass and furnished with a very good lever brake.

These reels are easily operated and, so to say, foolproof provided one refrains from jamming down the lever too hard. Sea reels used under the rod, without a lever brake, but provided with the star brake, as in use with big game reels, are also on the market. They are excellent, but demand a little more experience, as the judicious handling of the star brake during the excitement of a good fight demands some practice.

The American style of reel, fished over the rod, such as Pflueger's Capitol reel, is a delightful tool, once it has been thoroughly mastered and every manipulation has become quite mechanical and automatic.

These reels are alike to the well known lever-winding casting reels, but omit the level winding device. By a simple manipulation all tension on the line may be instantly removed and the line made to run free. Further there is a check and a star brake and there is scope for braking directly on the line by thumb and pad.

For fishing in the open I generally set the star brake at just sufficient tension to prevent overruns, and in case of a strike operate it as required, or do everything by thumbing.

When fishing for bahmin near rocks I set the brake harder in order to parry snagging tactics, and supplement this by thumbing as the occasion may require.

The Capitol No. 7989 is just the right size for Karwar. It has the advantage of also being a first class surf and sea casting reel.

The expert, intending to circumvent feeding surmai by bait-casting methods, must possess a good double handed casting rod in addition to his trolling outfit.

There is not much really suitable material for this purpose on the market in this country and such rods have to be either ordered or homemade.

I own an excellent and very cheap homemade one, composed of a 28-inch butt and a 6½-feet tip, the latter being ringal cane. I am quite aware that a split cane or greenheart tip would be superior, but such things are not to be had in these days.

These long single-piece tips have a most wonderful action and are a joy to use.

The fisherman possessed of a one-handed bait casting outfit may find occasional use for it with the wolf herring or small *Caranx*, as well as in the rivers of the vicinity, some of which, as the one running for a distance along the road to Belgaum, hold mahseer, wallagoo, murrel and olive carp in numbers.

Lines.—Nothing but the very best flax lines will do in serious sea fishing. Sea water coupled with hot sun is very hard on a line anyhow. For trolling I recommend nothing less than 150 to 200 yards, as the end of the line gets inevitably frayed on rocks and has to be cut back a bit from time to time, i.e. the line must be frequently inspected even during a day's fishing.

An expert will do well with 18 strand cuttyhunk at bahmin fishing and work near rocks in general.

For work in open water he will probably prefer to use lighter lines such as 15 strand cuttyhunk or even 12 strand.

These lines are permitted by the rules of reputable fishing clubs in most parts of the world, and are strong enough to deal with fish such as those met with at Karwar, provided always that the water is not snaggy.

Beginners, or casual visitors without much experience, would be well advised to use stronger lines, to avoid loss of tackle and loss of most of their good fish.

The 'locals' use nothing below 100 lbs. B.S. so as to be prepared for 'all comers'!

It is advisable to double one's line at the working end over a length of 2-3 yards.

For drift-lining and bottom-fishing expensive lines are generally not used, at least not new ones. Those used already for one season or two will do, or cheap bazaar lines.

Traces.—Sea water corrodes ordinary steel disastrously. It is therefore recommended to use stainless steel wire of up to 50 lbs. B.S. This was on the market in rolls of 50 or 100 yards at quite reasonable price, and could be made into the usual 5-6 ft.

traces quite easily, with a box swivel at one end and some kind of an attachment swivel at the other.

These two swivels are ample.

In putting on swivels care should be taken not to twist the end of the wire round the length. Both parts of the wire should be twisted equally, for the first three twists. Then finish in the ordinary way.

Gut is not to be recommended, except for small fishing. My experience with gimp traces was also not very encouraging. If no stainless steel is available even brass wire will do. It will have to be rather thick and is an eyesore to most fishermen, but the fish do not seem to mind it at all.

The use of attachment swivels is often criticized very adversely. However, they are very convenient for a rapid change of lure, and quite honestly, I have never yet lost a fish on account of the swivel pulling out. It is probably just the difference between using only first class stuff and looking at the price too closely.

Lures.—Traditionally, the most successful all-round lure is an oval shaped copper and silver or gold and silver 3-inch super mahseer spoon. It should be armed with a very stout single and a very large treble as a tail hook. Thus weighted the spoon will just produce the very display, so attractive to the fish.

The same spoon in the $2\frac{1}{2}$-inch size serves well when fish run smallish.

Many other spoons have been tried, of all colours and shapes and sizes, but none has ever even remotely equalled the above in all-round steady success.

It must however be admitted that surmai take a 4-6 inch all-silver wobbler very well.

A flying mount produces more rapid motion in the spoon, but this is not appreciated by the fish.

I have used a $3\frac{1}{2}$-inch spoon of the super mahseer pattern. It was quite frequently taken, but less so than the 3-inch size.

The pretty Japanese feather-squid so deadly behind a motor boat, is useless at Karwar, as the canoes are too slow.

Plugs of $3\frac{1}{2}$ inch to 6 inch are readily taken. However, these beautiful but very expensive lures suffer terribly from the jaws of these strong fish and are seldom in use.

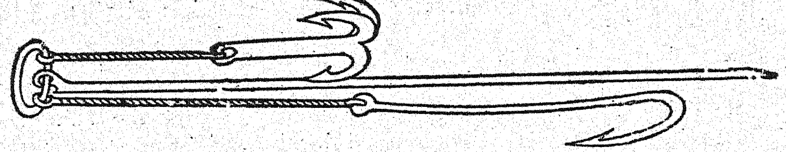


Fig. 61.

For dead bait, a very simple device is easily rigged up by means of a brass ring, a single and a treble hook and some wire. A spike for impaling the bait may be added. (See figure.)

Beware of too much spin and stitch up the fish's mouth!

Gaff.—A good gaff with a $3\frac{1}{2}$ ft. haft is essential. A priest or knife for killing one's fish should be carried. A good fishing

belt is a great convenience. A sandwich box and large thermos will be appreciated.

A good topi and spine pad are strongly recommended.

Wash your lines in fresh water after every day out, and dry in the shade. Clean your swivels and spoons in the same manner and grease them until in use again.

Be generous to your crew in the disposal of fish. It pays.

If these unpretentious notes should prove useful to visitors to one of the loveliest spots on the coast, they will have fulfilled their purpose.

5. BAHMIN IN MALABAR by MUNISHEH

To the scientist he is known as *Polynemus tetradactylus*, in more common parlance 'Bahmin' (Malayalam); to the unfortunate who tries to catch him, 'a devil incarnate'.

He lives, amongst other places, on the West Coast of India in close vicinity to tidal creeks; is said to attain to a length of 4 ft.; and is very rarely above 20 lbs. in weight. But the normal size caught on a rod and line varies between 3 and 7 lbs.

Having previously heard of and read of his prowess, on being ordered to the Malabar Coast, I was determined to try my hand at catching this most elusive fish. The combined experiences of myself and some friends may prove to be of interest.

Having studied minutely all that those recognised authorities on fishing in India—'Skene Dhu' and H. S. Thomas—could tell us on the subject, we now, with the greatest of deference, beg to differ on several points. The authorities instruct one to be satisfied with spinning one's lure round the piers of rail and road bridges. These span the rivers and creeks every few miles up and down the long coastal strip. Apart from the fact that the fish seem to haunt these spots only when conditions in other places are not suitable, the added difficulty of dealing with such a wild creature rushing madly in and out of any obstruction that may give him the least opportunity to break, causes one to avoid such localities as far as possible. Also, it is not everybody who has the head to walk placidly up and down the open sleepers of a railway bridge. Most of the rivers on this coast have very narrow mouths, in and out of which the tide runs at great speed, and there are definite bars about 400 yards out from the actual line. Experience has proved that there is more probability of finding the fish in either of those spots, rather than inland near the bridges.

The chief difficulty is to ascertain the time that the fish are likely to be present at one's selected locality. There appears to be no reason for their movements. One day they will be there in their hundreds. The next day with identically the same conditions as regards temperature, water, tide, light and wind, there is not a fish in sight. The most probable times are, however, early morning and late afternoon.

The second main point of difference is the question of lure to be used. The authorities recommend an almost exclusively dead bait. This has been tried, and in addition, phantoms and spoons.

The best sport was obtained by using a large and heavy spoon—three inch size being the very smallest. Even a small bahmin of $1\frac{1}{2}$ lbs. will take this without any hesitation. A heavy spinning rod with a reel capable of carrying 150 yards of stout line is a *sine-qua-non*.

The method adopted is to be at the selected locality at the same time as fish have been reported to be rising on the previous day. A rough country boat is procured, with two paddlers, and one possesses one's soul in patience in the hope that a rise will occur. If one's luck is in, there is no chance of missing that rise. The water boils and foams with maddened fish. The boat is propelled as fast as possible to the spot before the shoal moves on or disappears. Casts need to be long, and the line reeled in as fast as humanly possible. The spoon is liable to be taken at any time, from the moment it touches the water until lifted out preparatory to the next cast. On more than one occasion a fish has rapped its head against the boat in its last frantic effort to seize the lure. There is neither time nor necessity to strike; all that is required is a constant tight line. Needle-sharp hooks are an essential; the bahmin has a bony mouth, and blunt hooks mean almost certain failure. Even when safely hooked, the odds are still in his favour. He is up to every known trick of the trade, including dancing on the surface with his mouth wide open and wildly shaking his head. One fish landed and three spoons lost constitute a red-letter day.

Apart from his fighting powers, the bahmin's great curiosity is his eyes. To quote H. S. Thomas in 'The Rod in India':—'The eye is covered with a fixed transparent membrane through which the eye may be clearly seen moving free of it inside it, and which is so tough that Colonel Osborn has twice hooked fish foul by it and landed them.'

At Mahé the local people catch them on heavy bazaar-made brass spoons, attached by a complicated series of swivels and thick brass wire to a heavy hand line. They haul this in hand over hand at a far greater speed than can be attained by an ordinary reel. In less sophisticated places the lure used is a piece of iron, about the thickness of a middle finger, and 6 inches long. Attached to the lower end of this and lying in one place are two large hooks. Half way up the metal rod is attached one more hook. The whole thing, except the hooks, is then bound with a piece of white cloth and attached to a strong hand line. Every morning and afternoon men may be seen sitting on the high banks of sand waiting for the fish to show themselves. As soon as the rise occurs, the men run down the bank into the breakers whirling the lures round their heads and casting them a perfectly amazing distance. As soon as the lure touches the water, they run back up the bank hauling the line in hand over hand at the same time.

All anglers who come to the Malabar coast have heard of the bahmin; they all prepare their tackle, full of zeal. Many give up the unequal contest. Even the few that persevere have little to show as a reward for their patience, and leave the coast feeling

they have more than met their match. Some cease to regard it as a sport and term it a blood feud.

We hear that there are places outside Malabar where there are bahmin in great numbers at certain seasons, and that they can really be caught. We hope to visit them if opportunity arises, and have our revenge.

6. SEA FISHING (*West Coast*) by LIEUT.-COL. R. W. BURTON.

The West Coast of India, especially from Ratnagiri southwards, affords excellent sea angling at certain seasons and places. Gadsden has dealt with Karachi, Bombay, and other localities; and G. D. Traylen with Bombay especially. No intending sea angler should fail to consult all the articles cited on the first page of this Chapter. Dr. M. Suter has now dealt with fishing around Karwar.

All down the West Coast—the 'Canoe Coast' (the East Coast) is known as the 'Catamaran Coast,' the best of sport is to be had around the many islands scattered along the coast line, and at the channels where the many rivers enter the sea, also at certain places up the tidal backwaters, by means of the sailing dug-outs everywhere available. Below Tellicherry and Mahé, however, there are long stretches of coast where there is little prospect of sporting fish being found, except at certain states of the tide at the mouths of the several estuaries; and the only places worth a visit are Beypore, Cochin, Quilon, at all of which accommodation exists, and Muttam. Opposite Muttam is Crocodile Rock where is 23 fathoms of water and many big fish of several species. Here is no sailing dug-out, the local craft being catamarans. Boat would have to be arranged for from further up the coast. The flat rocks are named by the boatmen of Muttam as '*Tharai-par*'; and the steep rocks '*Usantha-par*'; and the boatmen give names of Tiger shark (*Rajah, Thiruvalli-kalan, Pullyan soya*), Saw Fish (*Vela, Iluppa, Vaalu srava*), Tunny (*Choorai, Soorai, Kethal*), Bonito (*Ela-choorai, Mass*), Seir (*Nedunthalai, Varian*), Elacate nigra (*Kada viral*), Sword fish (*Thalapattu*), Spear fish (*Kopparah, Ola-meen*). Evidently Muttam is a place to visit, *with a proper sailing boat*. Season: October to February. No accommodation. Mention should also be made of Sacrifice Rock, 20 miles south-west of Mahé and 7 miles north-west of Cotta Point, where the depth is around 13 fathoms and many seir, caranx, and gar-pike can be caught.

Local enquiry has to be made as to time when the surface feeding fish are passing down the coast within the period mid-September onwards to mid-January; and this applies to whatever part of the coast is visited. At Quilon in the last week of December no seir were found, as the latter part of November and early December is apparently the time for them there.

Around the islands and rocky places one hopes for seir, caranx, mooloo (*Elacate nigra*), rock perch of several varieties, and gar-pike: bahmin, nair, mullet, gar-pike, and some other varieties are to be had at the channel entrances and up the tidal portions

of the rivers entering the sea. But it is only the angler who has the leisure and opportunity to camp at such places (estuary outlets to the sea) who can be fairly sure of sport, for most of the river mouths are difficult of access and fishing can only be had at certain states of the tide, the time for which naturally varies from day to day. So camp one must, or undergo many blank days and disappointments.

The season for the angler, whichever portion of the West Coast he may select or have available to him, is from the close of the South-West monsoon about mid-September, to the middle of January. There may be fishing after that time but the writer is not able to say so.

Within the period mentioned the best time to fish varies all down the coast. Sometimes the monsoon closes by the end of August and then some of the surface feeding fish are migrating earlier: and off Karwar the bahmin may be more numerous and larger in size. As a rule it is not worth planning to fish before mid-September; and during October, sometimes early November also, violent storms may put a complete stop to all fishing for as much as ten days at a time, so those without leisure, or patience to wait, have to go home.

There is yet much to be learnt about the movements of commercially important and sporting migratory fish such as the seir and larger mackerels. This would involve a complete acquaintance with the smaller fishes and other food on which they feed, as their movements must be largely influenced by search for food. It is by reason of the presence of myriad shoals of 'sardines' of the herring family, and of the common mackerel (*Scomber microlepidotus*) which appear on the Malabar coast after the South-West monsoon, sometimes also large shoals of mullan (*Equula splendens*), that the large surface feeders are present; but there must be more to it than that or these fish would remain all the time with the shoals and not move down the coast as they do. Probably the reproductive urge is at work and the sumptuous feeding on sardines furthers that impulse. Where they go to spawn is not known; it is likely to be over banks far out to sea, of which there are several—, or it may be in the Gulf of Manaar.

Fishermen come in their fine boats from Ratnagiri to Malpe and from there go out of sight of land, this in the month of November, and bring in large catches of seir, kora, and other big surface feeders, also shark, so this is the time for the angler to visit Malpe, and the coast line for some distance above and below, as the writer has found. If the sea current is setting to the north there are no fish; the seir etc. come along with the shoals when the current comes from the North. Big storms often upset the season for a fortnight at a time, these upset the ocean currents. Mid-November is good because after the first week of that month storms are unusual.

An essential to successful sea angling is—as said elsewhere by the writer—to get a firm grasp of the habits and nature of the particular fish in quest; determine the method which will present the lure in the most natural way; ascertain what pattern of lure,

or natural bait is most deadly; select the most suitable locality; and ascertain (the first essential) the precise part of the month or time of year during which the various species are to be found at the selected place.

There should be careful study of the weather and condition of the water, for sea fish, almost as much as freshwater fish, are affected by the temperature and condition of the sea and strength and direction of currents.

Causes of failure of newcomers may be mostly attributed to wrong gear, bait, locality, and judgment of water and weather conditions. Advice of local fishermen, although they may know nothing of rod angling, is most valuable as to exact locality, time, bait, and depth at which to fish: this last being very important. Local people give ready help as they are interested in one's success, for the sportsman usually gives the bulk of the catch to those who assist him to obtain it.

Only by reading and studying all the articles cited in this Chapter will the sea angler arrive at that success which he would otherwise attain at long last through vexatious and expensive experience. For instance, Gadsden had much success at various seasons but had evolved a killing method of baiting and presenting the prawn.

Except perhaps at Cochin and Quilon, where a friend might be able to arrange for a power launch, the angler has to depend on the sailing dug-out and the breezes that blow. Fortunately the wind is off-shore from early morning to mid-day and at that hour very punctually changes round to waft one back to land.

At a number of places the sailing dug-out is a fairly suitable arrangement, but all the same a good deal of valuable fishing time is wasted. The ideal for a keen angler with the necessary leisure—and not shy of a roughish time as to bodily comforts—is to hire a country sailing boat of about 15-17 tons, with a crew of six men and a sailing dug-out in tow, and live on it, so being free to go anywhere along the coast, anchor at a suitable place, and go off in the dinghy, or out to sea. Laccadive islanders have great fishing over the Padua Bank 150 miles west of Mangalore. This during December-January when storms very rarely occur.

There are many species of fish in Western India seaboard waters. Vernacular names change along the coast as the language of the people changes. Bombay to Ratnagiri Mahratti is spoken; then comes Goanese; Canarese; Tulu; Malayalam; Tamil; and along the East Coast north of Madras, Telugu; but even so the names of the fish will sometimes vary within these linguistic limits. Therefore one should have a scientific list to refer to and then, recognizing the Family to which any species belongs, a vernacular tag can be applied to the fish. Much of interest is lost if one does not know the names of fish taken: and the information is useful to others.

Mahratti names of a number of fish can be known from the Series 'The Fish Supply of the West Coast of India' elsewhere

cited; and a scientific list with Travancore coast names is to be found in the *Journal of the Bombay Natural History Society*, vol. xxxiii page 347 et seq.

The writer can give names of some fish as known on the coast of South Canara and Malabar.

True mackerel ...	*Cybium guttatum* ...	Canarese, *khullkul*; Tulu *anjal*; Malayalam, *vari, meen*.
Do. ...	*Cybium commersonii* ...	Canarese, *arkulai*; Malayalam, *ayakoora*.
Do. ...	*Elacate nigra* ...	Mangalore coast, *mooloomeen*.
Horse mackerel ..	*Caranx*, of which a number of species	Canarese, *parai*. Mangalore coast, *para, kanayan para*.
Do. ...	*Chorinemus lysan* ...	Mangalore coast, *pala, pala meen*.
Bahmin ...	*Polynemus tetradactylus*.	Canarese, *vameenu*. Malayalam, *Bamin*.
Thread fish ...	*Sciaena*, sp. two or three varieties.	Do *kora*.
Shark (dog-fish) ...	*Chiloscyllium griseum*, A shallow water shark.	Malayalam, *oodumbi shirav*.
Shark (ground shark of rivers).	*Carcharias gangeticus* ...	Malayalam, *sravu*. Canarese, *tamasi*.
Shark (hammer head).	*Zygaena blochii* ...	Malayalam, *kannankodi*. Canarese, *kabbethatte*.
Shark (tiger shark) ...	*Galeocerdo rayneri* ...	Tulu, *pilthatte*. Malayalam, *pullian sravu*. Do. *makara sravu*.
Skate ...	*Rhynchobatus djeddensis*.	Canarese, *elti-balliar*.
Cat-fish (Marine species).	*Arius, sp.* ...	Malayalam, *yata, etta*. Canarese, *thede*.
Sting ray ...	*Trygon sephen* ...	Malayalam, *nei-therandi*. Canarese, *neitherake*.
White pomfret ...	*Stomateus sinensis* ...	Do. *manji*.
	Do. cinereus ...	Malayalam, *vella avoli*.
Black pomfret ...	*Do. niger* ...	Canarese, *chandratata*. Malayalam, *karapu avoli*. Do *karutha akoli*.
Herrings and sardines.	*Clupea longiceps* ... Oil sardine, migratory ...	Do. *nalla mathi*. Canarese, *baige*.
Do.	*Clupea fimbriata* ... Oil sardine, migratory ...	Malayalam, *chella mathi*. Canarese, *pedi*.
Do.	*Clupea lile* ... The Malabar sardine, migratory.	Malayalam, *veloori*.
Do.	*Dussumieria acuta* ... The Malabar sardine, migratory.	Do. *kolachi, kolakayan*.
Silver bellies ...	*Equula splendens* ... The Malabar sardine, migratory.	Do. *mullan*.
Silver bellies ...	Family Gerridae ... Sometimes found in large shoals hunted by *seir, kora, Chorinemus lysan* etc.; length up to six inches.	Canarese, *kurichi*.
Gar-pike ...	*Belone, sp.* ...	Mangalore Coast, *kandai*.
A caranx ...	......	Do. *kadai*.
A spotted perch ...	......	Do. *ambai*.
Another perch ...	......	Do. *anjel muri*.

The common mackerel forms the main fish harvest on portions of the Malabar coast, and is the fish one mainly uses for dead and live bait when fishing away from the shore. It is *Scomber microlepidotus*, about 3 to 5 to a pound, Mangalore coast *bangada, bagala,* also *ila*.

The Great Indian Fin Whale is very rarely seen. So it was a great surprise when one of these huge creatures uprose about fifty yards from my anchored boat near Sacrifice Rock.

Of all the fish listed above *C. guttatum* is perhaps the most prized by the angler, as it runs to six feet and 60 lbs. and speeds like a race horse. *E. nigra* is a most dogged fighter. Those caught by the writer have not exceeded 40 lbs.; but the fishermen say they grow 'as big as three men' and are sometimes so taken in their nets. I have no confirmation of this, and doubt it. Day does not mention size limit.

All horse mackerel (*Caranx*) fight well; fighting qualities of bahmin are well known, the ordinary size is five to ten pounds or so, and around Karwar up to 25 lbs. may be taken. There is record of 34 lbs. at Goa (*'The Field'*, April 1930). Gar-pike are 2 to 5 lbs.: 10 lbs. is a big one. Mullet may be up to 2 lbs. or so. As to fishing for the above (mullet and gar-pike) Gadsden should be read as to baits and tackle so also for bahmin. Gadsden and Traylen deal especially with sea angling around Bombay.

Part of the definition of what constitutes sport may be said to be the making of it as great a test as possible consistent with reasonable fulfilment of the main object in view. From this standpoint, with tackle to suit the weight of the species as ordinarily caught, the bahmin is in a class apart from other sea fish off the coast as he is indeed a contrary and elusive creature. So perhaps something about the bahmin may be of interest and use to intending anglers.

Gadsden describes him as a magnificent, game-looking fish and something of a cross between a salmon and an English sea-bass. More handsome than the salmon though not so aristocratic looking.

Apart from appearance the bahmin can be likened in a number of respects to the English sea-bass. He is a sea fish, as is the bass, and is equally fond of running up estuaries; he can be successfully fished for from the shore in the roughest weather; he has a varied diet, but is especially fond of prawns and small fish; he prefers a spoon bait silvered on both sides, with a silver of mackerel tailing on the end hook; he takes a fly; and is much esteemed as a fish for the table.

In all the above respects the two species are alike. They are also alike in that both of them are the most difficult and contrary fish with which it is possible to try conclusions. Like bass, bahmin are found in-shore and around rocks. They are fickle and difficult. One day they may be caught and the next, under apparently precisely similar conditions, they will wholly elude one. When in pursuit of bahmin one should bear in mind all that is written by expert anglers for bass. In one respect they are different: the sea-bass takes a prawn by the tail, the

bahmin by the head. If a live prawn be used it should be hooked through the last but one segment from the tail and the trace continued for another hook to be placed below the head and tied there (also the in-between piece of trace) with coloured thread. Other fish besides bahmin may take the bait, and mounted in this way it is ready for all comers. If the prawn be hooked through the head it does not live long; in quiet water a lively prawn is the better bait.

If a dead prawn is used it is best mounted in Gadsden's way. Whatever the bait may be the size of hook must be suited to the bait, and the bait fished at proper depth, being kept there by lead of suitable weight. Two or three feet below the surface may be usually correct but circumstances must decide. If speed of the tide does not keep the bait up a float of the sliding or 'release' type is essential. Both the 'Summers' and the 'Wallis' are good.

Reverting to the two species. They are alike in that the ordinary size taken is from five to twelve pounds; and differ in the rod and line maximum recorded weights, as the record for the English sea-bass around the coasts of England and Ireland is close to 17 lbs. and the bahmin has been caught up to 34 lbs.

It is well, in this place, to say something regarding the genus *Polynemus* of which there are as many as eight species (Day's Fishes). Of these, two only attract the attention of the sea angler, the others being small fishes.

In the *Rod in India*, second edition, page 210, the usual descriptive quotation (from Day's Fishes of India, Burma and Ceylon) of both *P. tetradactylus* and *P. indicus* will be found. No mention of *P. plebeius* is made in the book.

In vol. 34, No. 4, pages 979-980 of the *Journal of the Bombay Natural History Society* will be found much of interest regarding the two larger species of bahmin. It seems the Mahratti name '*Ravas*' is applied generally to all the *Polynemus* species. It may well be the case that sea anglers catch not only *P. tetradactylus* but *P. indicus* also.

In an article on 'Estuary Fishing as an Industry in Western India' W. A. Wallinger gives at page 635 of vol. 17, No. 3 of the Society's *Journal* a list of fish taken in, and at the mouth of, the Kolaba greek classified according to their size and habits. Under 'Large Migratory Fish' weight of *P. tetradactylus* is given as 'locally said to attain 168 lbs.' while in the margin is remarked 'Buchanan gives 320 lbs'.

The origin of this 320 lbs. statement passed on from one writer to another evidently emanates from Dr. Day's 'Fishes of India etc.' where he gives the size of this species as 'attaining six feet and upwards in length' and adds Hamilton-Buchanan observes: I have been assured by a credible native that he saw one which was a load for six men, and which certainly, therefore, exceeded in weight 320 lbs. avoirdupois.

In that same list (Wallinger's) *P. plebeius* is 'locally said to attain 50 lbs.' while no mention is made of *P. indicus*. Day gives length of *P. indicus* as four feet, and weight as 'rarely above

20 lbs'. At page 979 of vol. 34 we find from records of the Steam Trawler 'William Carrick' that the average weight of *P. indicus* taken in the nets was 13 lbs., and the heaviest individual fish of this species recorded was 34 lbs.—total length 3 ft. 8 inches. No specimen of *tetradactylus* larger than 15¼ lbs. was taken by the trawler.

Wallinger calls *P. plebeius* 'Dara', which is the Bombay locality name for *indicus*. It is certain that his 50 lbs. refers to *indicus*, and his 168 lbs. for the other. 'Rawas' is probably a mistake of the informing fishermen. Anyhow we are still without sufficient proof of the size to which *Polynemus* attains beyond the specimen of *P. tetradactylus* 38 lbs. captured with a cast-net in very shallow water south of Pamban as witnessed by Sri E. K. Mahdavan, Assistant Director of Fisheries, who says that *P. indicus* is also found in that locality.

It remains to say how these two species can be readily distinguished, and leave to future sea-anglers the pleasure of contributing records of weights to the Honorary Secretary of the Bombay Natural History Society.

Polynemus tetradactylus—

Four free pectoral rays reaching to the end of the ventral. Air-vessel absent. *Colour*. Silvery-green, becoming yellowish-white on the sides and abdomen, dorsal and caudal grayish with minute black points and nearly black at the edges : ventral and anal pale orange in their outer halves, pectoral filaments white.

This species is a more shapely fish than the next and has the silvery sheen and graceful body contour which call to mind comparison with the true salmon of the north. (Vol. 34, p. 980.)

Polynemus indicus—

Five free pectoral rays reaching nearly to the anal fin. Air-vessel long and narrow. Vertical fins dark edged. Lateral line continued along the lower caudal lobe almost to its end.

Colour, black purplish black, abdomen silvery white, dashed with gold. First and second dorsals, also anal, stained with black as is likewise the lower half of the opercle. Caudal with many black points.

Tackle for Sea Angling.

Until fairly recent years sea rods, lines, traces, etc. have been unnecessarily coarse and heavy. This still obtains to some extent. It is seldom one catches with rod and line off the coasts of India fish heavier than sixty pounds. Take the seir fish, 200-250 yards 9 cord cuttyhunk is sufficient; so also for bahmin. There is no real reason why sea tackle should be coarser and heavier than freshwater tackle. If it is wished to struggle with big sea perch of species which grow to hundreds of pounds in weight it is better to anchor and use a heavy hand line. If such fish are hooked when trolling for surface feeders the best thing is to break away, if necessary, and in anticipation of that contingency the trace should be of lesser breaking strain than the line. That indeed is a usual practice in most classes of angling.

Rods.

The best sport is obtained by use of a spinning rod of greenheart (preferably spliced) or ringal cane (not split cane—the sun,

sea water, and humid climate will soon ruin it), length about 8 feet for boat work. All metal work brass or rustless, rings protected porcelain, or agate, end ring side-protected also. This rod for surface trolling around rocks and islands, and drift-line fishing. The cork handle in front of reel should be wrapped over with whipcord to give nonslip hold.

For fishing from the shore and at estuary channels a longer spinning rod is better. The writer uses 10 ft. 6 in.

For mullet and estuary gar-pike, a trout rod and light tackle.

The majority of modern anglers, both sea and freshwater, prefer the short bait-casting rod, or a modification of it, and multiplying reel. The use of such an outfit has many advantages. Though the rod is not very suitable for trolling it is valuable for its easy overhead and far-casting capacity, especially when a school of bahmin is feeding on the surface, or one is fortunate enough to be close to a shoal of small fish being raided by seir etc.; and for gar-pike around island rocks; also others in the boat are not endangered by flying hooks. Stiff sea rods spoil sport unless the fish are very large, and those should be separately catered for. The spinning rods will cope with all one meets, and the springy action maintains hook-hold in bony mouths.

Care has to be taken to tire out a fish before bringing it to the gaff or it may go under the boat and smash the rod. Boatmen should be carefully instructed in use of the gaff. Carry a spare rod.

Reels.

The reel must be proof against sea water corrosion, of strong make, free running, have line guard, check, and adequate braking arrangement, and balance the rod in use. Nottingham brass backed reels of 5 inches diameter, also Bakelite and other makes of similar size, will give good service. Ratchet check reels sing pleasant songs but the teeth wear out. Spares should be carried. With all reels of this type one has to beware of rapped knuckles from revolving handles.

American and other multiplying reels of sufficient line capacity (200 to 250 yds.) meet requirements; but as all such reels have to be fixed on top of the rod rings need to be duplicated, and care taken that they are sufficiently close together to prevent wear of sagging line.

Reels of the silent and stationary handle type such as the 'Fortuna' and other makes, with the star brake controlling the drum, are longer lasting and give effective control of the fish at all stages of the fight. A 5-inch reel of this type will take ample line and fulfil all trolling and drift line fishing requirements for as heavy fish as the angler will need to deal with in Indian coastal waters.

It is likely that after the present War reels of more unbreakable plastic material than Bakelite will be on the market. The great advantage of plastic material reels is that their comparative lightness enables the rod to be suitably balanced with a reel of large line capacity. Carry a spare reel.

Lines.

It pays to use the best quality line. Cuttyhunk—12 thread (30 lb. b.s.) suffices for trolling. For spinning, and the casting rod, braided line is necessary. For float fishing the front 30 yds. should be of silk, and greased.

The whole line should be tightly wound on to obviate 'bird's nests' and disaster. The line should be double-looped to the swivel and whipped, without knotting, a few inches above.

Lines should be washed in fresh water after use; and for this purpose it is convenient that the line winder be of make and material to permit of immersion in the bath.

Line for trolling should be marked by red wool tags twisted in at 30 yds.—the usual trolling distance, 40 yds. for keeping the bait at greater depth, and 100 yds. It is well to have two tags a few inches apart at 40, and three tags at 100 so that, after dark, it can be known by feel what line is out.

The Sunn Hemp (*Crotalaria juncea*) is grown all along the coast. The fisher folk make their nets and lines from the retted fibre. In case of necessity one's trolling line losses can be quickly made good by use of a line twisted to order of length and thickness required, and waterproofed by rubbing with green fruit of a tree growing in many swampy places. It is *Diospyros embryopteris*, Malayalam, *Panichi*; Tamil, *Panichchai.*

The floats used by the fishermen for their nets are from the dried wood of the evergreen tree (*Cerbera odollam*) which grows along the coast, Malayalam, *Othalam;* Tulu, *Thendamara;* Tamil, *Kadama.*

In 1943 a 300 yds. 24 lbs. line made on the coast to order in 1935 at cost of Rs. 3 was loaned to a friend who killed with it, paste fishing, a 76 lb. mahseer.

Trace.

This should be of rustless wire. Killin wire can be used, but may entail loss of fish unless great care is taken for it very quickly rusts in sea water. Trace used in the morning may not be safe for the afternoon.

A wire which is quite rustless under any conditions is the Wissco Leader-Wire of polished stainless steel sold by the Wickwire Spencer Steel Company of New York and San Francisco. It is sold by weight and is not expensive. Takes solder well and does not corkscrew or kink. There are other rustless trace wires not yet tried by the writer. The 'Asal Special C.N.' and the 'Elasticum'. The former does not corkscrew or kink, and the latter stretches considerably without losing strength. On general principles the trace wire should have a less breaking strength than the reel line: also the finer one fishes the better. Generally the trace should be a foot or so longer than the largest fish one expects to catch.

Brass wire, annealed, makes a good trace. It is not sufficiently pliable for spoon fishing but does well for trolling. Indian coast fishermen use it for drift-line fishing and catch big fish. One writer on bahmin fishing used brass picture wire for traces

and found it better than anything else, but that was many years ago. The wire must be *brass* and not iron, 'brass-washed',--as is now mostly sold.

Swivels should be brass, or white metal (dulled, or fish may snap at them). Sizes to suit the tackle in use.

Brass wire connecting links are necessary for change of lure, whether spoon or dead bait, and can be made up by the angler.

All gear must be sound; any weak point will soon be made apparent by the fierce and furious rushes of sea fish which are considerably stronger, weight for weight, than freshwater fish.

Spoons.

Heavy spoons made from 1/16 inches copper sheeting and coated all over with silver solder, 3 in. long by $1\frac{7}{8}$ broad with 'dish' of $\frac{3}{8}$ inch are suitable for bahmin. These spoons should not spin very fast, to ensure which both hooks should be attached to the spoon itself and not fly loose, and be wobbly in action. With the bait casting rod smaller spoons have to be used. Spoons for bahmin, as also for all sea fish, are improved by a thin sliver of silvery mackerel attached to the end hook.

For seir and other pelagic fish a spoon with a wavy action, such as the 'Knowles Automatic Striker' ($4\frac{1}{2}$ inches), and the Gibbs Stewart, brass and nickel, size 6 ($4\frac{1}{2}$ in.) are good; so is the Japanese white feather bait; and probably the Pflueger Chum Spoon which has not yet been used by the writer: there are other designs also.

Best of all, for the big surface feeders, is a dead bait mounted to work in the water with a wavy action: dead baits for sea fish should not spin. A lure which is good over coral reefs and rocky places is a bright spoon, without hook, with a sliver of fish on a wire-mounted 5/0 hook trailing six inches behind the spoon. The mount must be attached to the trace and not spin with the spoon which merely acts as an 'advertiser' to the bait behind it.

An effective oval 'fly spoon' bait can be made from the triangular tail piece of a fresh mackerel. Sharp knife and scissors necessary. A single No. 1 eyed hook is passed through the silvery side and back again leaving the shank of the hook on the fleshy side. The piece of tough tail skin is tied to the trace above the hook eye in such a way as to give a somewhat convex shape to the silvery side of the bait. This is a good lure for gar-pike and other fish, especially in choppy water.

Hooks.

Single hooks should be Limerick bend, have turned down eyes, and be needle sharp. Treble hooks size 6 are large enough for most purposes.

Mount for trolling a dead bait is a single hook behind the gill on one side of the fish and treble hook just short of the waist of the tail on the other side, one hook of the treble being imbedded in the fish. Both hooks, and the wire between them, should be sewn to the bait with strong thread passing round the backbone. The mouth of the bait should also be sewn up and the trace arranged to pull from the centre. It is convenient to

have ready single hooks and treble hooks on different lengths of wire to suit several sizes of baits. The loops of these wires, passed from behind through the gills to the mouth are fastened on to the trace link. That having been done the hooks are adjusted and the sewing completed. Properly adjusted the bait works with a weaving motion and does not spin. For this and other mountings of baits the Wissco wire is the best to use.

Leads and sinkers.

Leads are not ordinarily needed for trolling: an assortment should be carried for spinning, drift-line fishing, and fishing with prawn. For shore fishing on sandy bottom a mussel shaped lead is good; and among pebbles a round lead. A yard of thin line from the lead to the reel line, or cast, or trace, will enable break away to be effected without loss of gear other than the lead.

Gaff.

Should have a gape of 3 inches, be lashed to a bamboo shaft to handle of which a lanyard. See that the gaff floats or it may be lost.

A 'priest' is necessary as the boatmen never have anything handy for killing fish; a lanyard for this also.

A landing net of salmon size may be needed for estuary fishing. It, too, must float or may be lost.

Procuring bait.

Hire of boat should include a stipulation for supply of bait. Mackerel and sardines are obtained from the many boats engaged in netting off-shore. Other small fish are obtained by use of circular cast net along the shore and in any near-by creek, where also are found prawns and crabs. Generally speaking there is always trouble over bait. The men dislike the extra work of searching for bait and will evade or shirk it if they can. If separate payment is made for bait the demands are exorbitant.

Boatmen's ways of keeping bait are crude and inefficient, bait goes bad very quickly. Proper baskets are necessary for prawns; a packing case with holes for circulation of water is best for live bait: a stone in it to make sink. The box and basket are let over the side to keep bait fresh and lively. Prawns must be on shady side of the boat: fish too if possible. Bait that is dead is best carried in a packing case filled with wet sand. If left to lie about in the boat it soon becomes bad and useless.

Ground bait is useful at times. Crushed crabs, or any crushed fish mixed with boiled rice and trailed from the boat in an open-mesh sack will do; or it can be sunk to required depth. Oil sardines squeezed and kneaded beneath the surface and allowed to drift down tide will serve; also such bait put in a string bag and weighted to hang from stern of boat. All of these will bring fish on the move to find the food it leads to—the angler's lure!

Cuttle fish and octopus tentacles are good bait for drift-line fishing.

Sundries and spares.

Anti-sunburn cream; brass wire, annealed, of several thicknesses; Carborundum stone hook sharpener (if it gets gummy from use, soak overnight in petrol and burn off the absorbed spirit —becomes as new); knife; needles; thread, red, black, white; pliers and wire cutter; watch repairer's vice; screwdrivers; files; oil (3 in one); oil—fish oil, on hooks and wire helps against rust; floats, fine quill for mullet, tapered cork for prawn, best colour is black above water with white water line; scarlet wool; white feathers; wax and silks for rod repairs etc.; leads of assorted shapes and makes and weights; lead wire; hank of whipcord; a 150 yard heavy cotton handline for sharks and big perch; 2 or 3 shark hooks; leather rod belt with socket for butt; soldering materials; line winder of large capacity (about 10 ft. at turn of handle).

A packing case with leather cushion; this is necessary in a dug-out as a seat and box to hold tackle and sundries. Lid should be arranged to keep out water, and the box zinc lined. A small piece of board on which to cut baits will obviate mess from such operations.

Spares should include plenty of various kinds of hooks; swivels; spoons etc., trace wire of several thicknesses; spoons and swivels can be cleaned by putting into a shallow dish of tomato juice; or immersed in a solution of salt and vinegar; dry with a soft cloth; solution can be kept for further use.

Rest House etc., Accommodation.

The following list indicates where accommodation can be had within reasonable distance of possible fishing localities. Places where there are Estuary mouths but no accommodation are also shown. At these it would be necessary to camp.

At many of these out-of-the-way Rest Houses very little is obtainable locally so it is essential to have with one camp bed: mosquito net; bedding; basin; tiffin basket with cutlery, plates, cups etc., food containers, box of essential stores, lanterns, k. oil, and an Icmic (charcoal) steam cooker.

Marmugao	...	Spencer's Hotel.
Karwar	...	Grand Hotel
Gangāvali	...	Estuary.
Tadri Creek	...	Do
Honavar	...	Estuary and islands
Coondapoor	...	Large Estuary.
Hangarkatte	...	Do. and P.W.D. Bungalow.
Malpe	...	Islands. Local Fund Rest House about 3 miles inland.
Kap	...	Do. do. in village on main road.
Mangalore	...	Netravati River and Estuary Municipal Rest House and P.W.D. Rest House
Kāsaragod	...	Estuary Chandragiri River. Local Fund Rest House.
Nilashwar	...	Estuary and backwaters. Local Fund Rest House.
Payangadi	...	Estuary below Mt. Dilli; Local Fund Rest House inland on hill above river. Ry. Bridge, Bahmin.
Cannanore	...	3 Hotels 'Seaside', 'West Cliff', 'Savoy'. Valaipatanam Backwater and Estuary 7 miles north by rail. Bridge Bahmin.
Tellicherry	...	P.W.D. Rest House; also The Tellicherry Club.
Mahe	...	Several Boarding Houses; possibly the Postmaster could inform.

Elattur ...	Estuary.
Calicut ...	Beach Hotel (in Old Malabar Club).
Beypore ...	Large Estuary. Local Fund Rest House.
Ponnani ...	Estuary, P.W.D. Bungalow.
Cranganur ...	Estuary and Backwaters.
Cochin ...	Malabar Hotel (Spencer's) on Willingdon Island.
Quilon ...	Rest House on main road. Under-sea rocks few miles to west, and bar to backwater and lake outlet 7 miles north.
Muttam ...	No accommodation.
Cape Comorin ...	First-class Government Hotel, fully furnished electric light Arrange by letter with Butler in charge for accommodation. Much fishing done by native fishermen using catamarans. Should be excellent sea-angling if suitable sailing craft available or procured from elsewhere. Language Tamil. Muttam about 12 miles north.

For occupation of Local Fund Rest Houses apply to President of the District Board at H.-Q. Town of the District.

For Municipal Travellers' Bungalow apply Chairman of Municipality concerned.

For P.W.D. Bungalows apply to the Collector of the District.

7. EAST COAST SEA-ANGLING LOCALITIES

By Sri E. K. Mahdavan, B.A.

Assistant Director of Fisheries (Inland) Central, Madras

Locality	Fish
1. *Tuticorin.* Fishing by sailing boat inside Harbour, Steamer anchorage, and adjacent Islands. P. W. D. Bungalow.	Cock-up, Bahmin, Kalawa (*Lethrnus*), Velaimeen (*Lutjanus*), Seppi (*Epinephelus*), Parai (*Caranx*). Season: June to August, December, January.
2. *Kilakarai.* Accessible from Ramnad. Old Port Office affords halting facilities.	Important centre from which special swift country sailing craft set out across the Gulf of Manaar, right up to the coast of Ceylon, trolling for seir (*Surmai*) with hand lines baited with sardines, coconut rinds, and rag lures. Season : May to August.
3, *Pamban Channel.* Accessible from Mandapam Railway Station, or Pamban Railway Station where Travellers' Bungalows are located.	Handlining by local anglers in the evenings, during December, from the viaduct for Cock-up. Stiff rod necessary to play the fish away from the standstone blocks, preferably from boats on the Southern side. Carry plenty of spares as breakages are to be expected. Live prawns best bait. Also plenty of *Chorinemus* at Kundugul Point. Bahmin caught during north-east monsoon close in-shore in shallows inundated by the tides. Season ; Cock-up, November to January, Sea Perch, June to August.
4. *Krusadai Island.* Fisheries Research Station. 5 miles from Pamban Railway Station. Apply for permission from Assistant Director of Fisheries (Marine Biology) West Hill.	Perches, especially *Pristipoma* around coral rocks to the north in Kundyal Channel. Boat rods best, with Nottingham reels. Cuttle fish strips—a very good bait in the evenings. Half-grown sharks in shallows at Sandy Point could be caught with Tope fishing tackle. Season: June, July, August.

LOCALITY	FISH
5. *Dhanushkodi Pier.* Well-known to passengers to Ceylon. Local Fund Choultry.	Cock-up in the evenings from Pier. Shoals of yellow-tailed mullets during February and March could be ground-baited as at Mauritius and caught on bread pellets. Salmon gut to be used. Season : June to September.
6. *Talaimanaar Pier.* Well-known to passengers to Ceylon.	Large hauls of Cock-up on live prawns from the pier during the season: June to September and November to January.
7. *Attankarai.* 3 miles from Ochipally Railway Station.	Cock-up and Bahmin during April and May.
8. *Sethubhavachattram.* 5 miles from Peravuruni Railway Station.	Cock-up and Bahmin during April and May.
9. *Adirampatnam.* Railway Station of same name	As above.
10. *Velankanni.* Well known Roman Catholic pilgrimage centre. 4 miles from Negapatam Railway Station.	Large numbers of Yeri (*Chrysophrus*) caught on live prawn from the bridge nearer to Velankanni after North East monsoon. Bahmin, Cock-up, and Indian Tarpon (*Megalops cyprinoides*) in same river nearer to that.
11. *Annaikkaranchattram.* 3 miles from Coleroon Railway Station.	A bad reputation for sea snakes and eels on the Coleroon River.
12. *Porto Novo.* 2 miles from Railway Station	Good facilities, especially in Killai oyster beds, for Indian Whiting (*Sillago*) during monsoon. Use fine gut and worm hooks baited with rag worms (*Polychaetes*). Megalops, Cock-up, and Bahmin also in season May to August, but variable. Canoe-shaped boats available.
13. *Buckingham Canal* from *Sadras* to *Kadapakkam.* Former easily accessible from Chingleput Railway Station by Bus 15 miles. Travellers' Bungalow at present (1944) not open to the public. Old Historic ruined Fort. A shark liver oil centre at Sadras and a Government fish-curing yard at Kadapakkam.	Travelling by boat in the Canal affords *Megalops* and Pearl Spot (*Etroplus suratensis*). Latter requires small hook, size 16, baited with earth worms. For the venturesome sea angler Seir, *Caranx*, Barracuda, and medium sized sharks a few miles out to sea.
14. *Covelong.* 17 miles by boat from Madras.	Good fishing for *Megalops* and fair for Cock-up and Bahmin. Season: February and March, but variable.
15. *Adyar River.* Southern boundary of Madras. Local Izaac Waltons have evolved an interesting tackle for catching mullets during Feb./Mar. which is strikingly similar in principle to those used by the Maltese mullet anglers. Fish are played by wading to prevent breakages.	*Rod* 10 ft. long of well seasoned bamboo reed. *Line* 10 to 11 ft. of thin even-twisted *Calotropis* fibre floated with peacock quill pith at 6″ to 12″ intervals. Mustad No. 12 hooks (mounted on cat-gut) baited with lumps of green filamentous algae (*Spirogyra* ?) and at times earth worm (well scoured).
16. *Madras City. Mouth of the COOUM.*	During the month of November there is an intensive fishing for *Sillago* (Indian Whiting). There were more than a dozen rods (of the type used for Mullets in Adyar) and the fun was fast and furious. Polichaete worms were used as bait. The fish are however undersized as compared to those in the West Coast rivers and creeks during the South West Monsoon floods.

LOCALITY	FISH
17. *Madras Harbour.*	I have it on hearsay that during normal times good fishing could be had with stiff rods for sea perches, including Cock-up and *Sparidae*, using prawn as bait. Fishing is banned now owing to War conditions.
18. *Ennur.*	Of late the Bahmin and Cock-up fishing has not been very promising. The best fishing area under the bridge is rather overcrowded during week ends. At these times hand-lining at the bar results in better catches of smaller miscellaneous fishes. The channel leading into the Salt Factory (which is not open to public) yields good catches of miscellaneous fish including Cock-up and Bahmin. The lock from near this stretch into the Canal on the North side attracts both Bahmin and *Megalops* (seasons very variable).
19. *Buckingham Canal.*	These regions which are connected to the estuaries generally afford interesting fishing for *Etroplus suratensis* the Pearl Spot. Small hooks and stiff short bamboo rods are best ; with mooga silk line and thin cat-gut cast. A float generally scares away the fish. Many other smaller fry could be captured on this tackle. It might be noteworthy that fishing in the locks of the Canal may very likely be thrown open to the sporting angler by the Canal authorities. I have suggested that they should be made to record a return of the catches on each day.
20. *Pulicat.* Nearest Railway Station is Ponneri, but best approached by boat from Ennur.	Good fishing for Cock-up soon after the North East Monsoon. The Lake itself affords *Megalops* and Jew fishes (*Sciennidae*).
21. *Dugarajapatnam.* 18 miles from Nayudupettai Railway Station. No bungalow so best approached by canal.	Cock-up and Bahmin after North East Monsoon. Large mullets during March and April should be tackled on a fly rod baited with green filamentous algae (same bait as in Adyar).
22. *Krishnapatam.* 17 miles from Nellore. Excise Department Bungalow, furnished, on bank of Estuary.	Fishing similar to above with the addition of *Megalops* in the creeks. With suitable rod and tackle big sharks can be caught. Some very large Cock-up have been caught here. There is a good inlet run when tide coming in. Then Bahmin are to be had on spoon and prawn.
23. *Vutukuru.* 10 miles from Kodavaluru Railway Station (second Station north of Nellore).	Mouth of the Peneru river. Good fishing for Cock-up.
24. *Singarayakonda.* 5 miles from Railway Station, no bungalow.	Good fishing for Cock-up ; December as well as June/July.
25. *Vetapalem.* Creek 4 miles from Railway Station.	Similar to above, with plenty of mullets. December as well as June to July.
26. *Kottapalem.* Mouth of the Kistna River about 30 miles by road from Masulipatam.	Cock-up, Bahmin, *Megalops*, and several perches. Seasons as above.

LOCALITY	FISH
27. *Masulipatam*. Good bungalow and stores. Local Fund Rest House near Railway Station East side of the town; has electric light installed.	Good boats and deep sea fishing for Seir, Tunnies, *Elacate nigra*. Season: June to August. Broad beamed deep sea boats available.
28. *Collair Lake*. 5 miles cross country from Kaikalur Railway Station where Travellers Bungalow. Guidivada Bhimavaram Railway Line.	Cock-up after North East Monsoon. Evidently attracted by the tremendous prawn fishery here.
29. *Coconada*, Good P.W.D. bungalow and stores.	Fishing somewhat similar to Masulipatam. June to August. Boats as at Masulipatam.
30. *Pentakota*. 7 miles from Tuni Railway Station.	Cock-up. June to August.
31. *Vizagapatam*. Good hotels 'Sea View' and 'Beach Hotel', both in Waltair 5 miles from Vizagapatam Town and Harbour.	Cock-up and other sea perches. Season, June to August.
32. *Sonapur*. In Orissa but nearest Railway Station in Madras-Ichchapuram. 10 miles. No bungalow, but obliging village Munsiff, and good oysters.	Bahmin and Cock-up, with numerous Cat fish and Jew fish.
33. *Gopalpur*. Great resort for bathing, 9 miles from Berhampore Railway Station.	A few Cock-up and smaller fry in the creek.
34. *Ganjam*. A forgotten centre of the Old East India Company days with its old Cemetery and crumbling brick Fort.	Small Cock-up and *Megalops* near the old mouth of the River Rushi-Kulya. A Government Fisheries Hut near the Road Bridge. Season: November to January.
35. *Ram-lanka on Chilka Lake*. Near mouth of Chilka chala. Nearest Railway Station, Huma, about 10 miles away.	Good fishing for Cock-up and Megalops. Season: November to January.
36. *Rambha on Chilka Lake*. Near Railway Station.	Good fishing for Cock-up and *Megalops*. Season: November to January, but very variable.
37. *Khallikota on Chilka Lake*. Balugaon do. Kalupara Ghat do. Balipatpur do.	The Raja should know about the *Megalops* and Cock-up. This area is sadly over-fished with nets and traps. During the winter plenty of ducks and other water birds.
38. *Puri and Kanarak*. Well known for sight seers.	Cock-up; but the chief attraction is the Temple ornamentation. The mouth of the Astrang river some miles to the north is however well worth a visit.
39. *Sandkut*. A Bungalow owned by the Raja. Apply Manager-in-charge, Kuganaj Estate.	Good fishing for Bahmin. In November 1940 saw them scaring the mullets on to the mangrove banks and actually snatching them from the mud (clear of water).
40 *Kujang*. On the Mahanadi 40 miles by road from Cuttack. Raja's Bungalow.	Great fishing for Cock-up, after the Monsoon, a few miles below.
41. *Chandipore*. Travellers Bungalow. Where the tide recedes for miles. About 12 miles from Balasore.	Good fishing from country craft for Cock-up, etc. in deeper water. Season November to January. A few flat-bottomed boats available. Local fishing mostly with stake-nets.

Chapter XI

TANK ANGLING

The fish (1). Best places to fish (2). The Bottom (3). The Rod (4). Hooks (5). The Float (6). The Mount (7). Machan (8). Depth of water (9). Ground baiting (10). Method of Fishing (11). Bait (12). How fish bite (13). Striking a fish (14). Playing a fish (15). Shelving banks (16). Season and Time (17). Cutla fishing (18). Mr. Corbet's note on Cutla (19). Mr. Kitchen's note on Cutla (20).

Tank Angling for Labeo.

In this chapter I propose to deal briefly with bottom fishing in tanks for Labeo, Mirgil, and Cutla. For those wishing to further their knowledge I strongly recommend Thomas' *Tank Fishing in India* or better still *Hints to Amateurs in Tank Angling*, by P. N. Bhattacharyya, which cover the subject fully. Fishing for the predatory fish in tanks is dealt with in Chapter VII.

Although Mahseer rightly take pride of place with the angler in India, circumstances may not always permit or satisfy his wants. He may find himself stationed hundreds of miles from the nearest Mahseer water, with little opportunity of getting away. It is under these conditions that he has to turn to other fishing if one is still to enjoy the sound of a singing reel. The Rohu or Labeo and his two cousins run large and are strong fighters, and no mean game. Do not be discouraged by the Mahseer conqueror of fly fishers scorn, laughing down bottom fishing. If once tried to success you will be converted. These fish are to be found in tanks within easy distance of almost any decent sized town in the plains of India.

The method of fishing is a technique worthy of the best elements of angling, and on entirely new lines, to that of the float fisher in other countries.

Before settling down to the vigil of the float, standing upright, and only one inch out of the water, let us consider a few general principles, and why this is different to other forms of fishing.

1. *The Fish.*—The mouth of the Rohu (*Labeo*) is ridiculously small for his size but is well provided with taste buds, and situated well below the head. The same applies to the Mirgal, but to a slightly lesser degree. The Cutla has no taste buds, but a large mouth badly put on with no upper lip, thus causing the mouth to open upwards. This makes them all feed and take bait

in a similar manner, i.e. by sucking in their food, much as a puppy does, when feeding from its mother. Their natural food appears to be slime and weed on or near the surface, and organic matter on the bottom; but paste and worms are readily taken, and provide an ideal bait.

It is to the peculiar nibble with which these fish take the bait, that tackle has to be adapted, in order to detect the slightest movement of the baited hook.

The float must be light and sensitive, a porcupine quill or the tail feather of the Peacock cut to a suitable length and bound with silk do excellently when adjusted correctly so as to register the minutest bite.

2. *The Best Places to Fish.*—Time spent in the selection of firstly the tank, and secondly the part of the tank, is well repaid.

Old tanks with weeds or masonry walls or steps, that are land bound with no water escape, will generally hold good fish. This is provided it is protected from netting and does not dry up in the hot months.

Having selected an old tank and satisfied yourself that it holds *Labeo,* the next point is to select a suitable place from which to fish, and erect a machan, if you can reserve a place for a fee.

Here are just some of the points to consider in the selection of a site.

(1) Avoid sitting with the sun in your eyes, and as far as possible select a part of the tank shielded from the wind.

(2) The bottom flat and firm, at a depth of from 4 to 6 feet.

(3) Should there be a *Ficus* tree overhanging the tank, select it to fish under. All fish are attracted by ripe figs or berries. Bathing ghats; where pots and pans are washed; near masonry walls or steps; at the entrance of water feeder channels,—are all good places to select.

3. *The Bottom.*—Survey the bottom with a plummet, and where-ever possible select a flat portion, this is very important for the correct adjustment of the line and float. Most tanks are however basin-shaped with shelving sides, special adjustment to the float must be made in such cases. (See Fig. 8.)

Having considered the fish and selected the tank and fishing site, we will now consider tackle.

4. *The Rod.*—Cheap ringal rods can be obtained in the bazaar of any decent size town, their price, mounted and fitted with rings, is only Rs. 4 or 5. Better rods can be had from any of the tackle makers. Ten feet or so is quite long enough, it must however be fairly stiff for brisk striking, the same as a casting rod, on 'Wee Murdoch' lines.

Cheap brass reels can be had for Rs. 10 or so, and are good enough, with 100 yards of line.

Twisted or plaited lines can be had for Rs. 4 or Rs. 5 per 100 yards. The Tussa silk lines are the most favoured, as they

are elastic and give with the strike which is necessary. They are cheap and very strong. Any good line does. I myself favour a smooth green or black line, not the khaki colour, and rough coil of the Tussa which must set up reactions in water.

5. *The Hooks.*—The short shank variety is the best for this form of fishing, and the types made in Calcutta and stocked by Mantons and called 'For India' are as good as any. I like Hardy's best. I give here a diagram of one I had specially made by them.

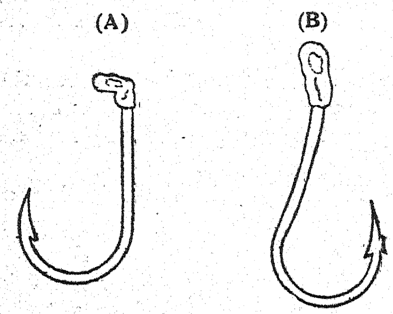


Fig. 62.

(A). The advantage of A over B is the short barb to the point of the hook, for easy penetration. And the wide rounded sweep of the hook and turn down eye, for direct draw by the line.

The important thing is a short shank with a sharp point, and a thin short barb. [See Fig. 62 (A).]

6. *The Float.*—A quill float made up of either the tail feather quill of a peacock, or a thin porcupine quill. In the case of a feather quill, it is made up with fine cotton or silk lashings at intervals of ½ an inch, to enable one to detect the slightest movement of the float. It should be about 4½ to 5 inches long, with a loop at one end a couple of inches long. (See Fig. 63).

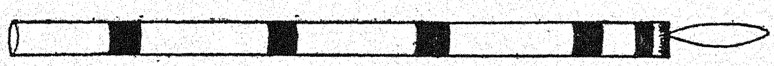


Fig. 63.—A quill float.

The float can be either attached or taken off quite easily, by bending the line double, passing it through the loop and over the end of the float. This gives one a slip knot over the line, so that the float can be run up or down the line to the required depth.

7. *The Mount.*—For very clear water, a good mount is a single hook mounted to a couple of lengths of stout gut, with a small lead, the weight of 2 or 3 B.B. shot. In coloured water, the ordinary mount with two hooks is good enough, mounted on to line. This then completes the outfit, the whole of which should be obtainable for Rs. 30. (See Figs. 64 and 65.)

8. *The Machan.*—These can be made from either bamboo or timber, though the latter is the better, and this I consider the most important factor to success. The machan must be *rigid,* as however expert one may be at sitting still, there are times when

movement is necessary and if the machan is not quite rigid on its supports, fish are frightened away; the lower the platform is to

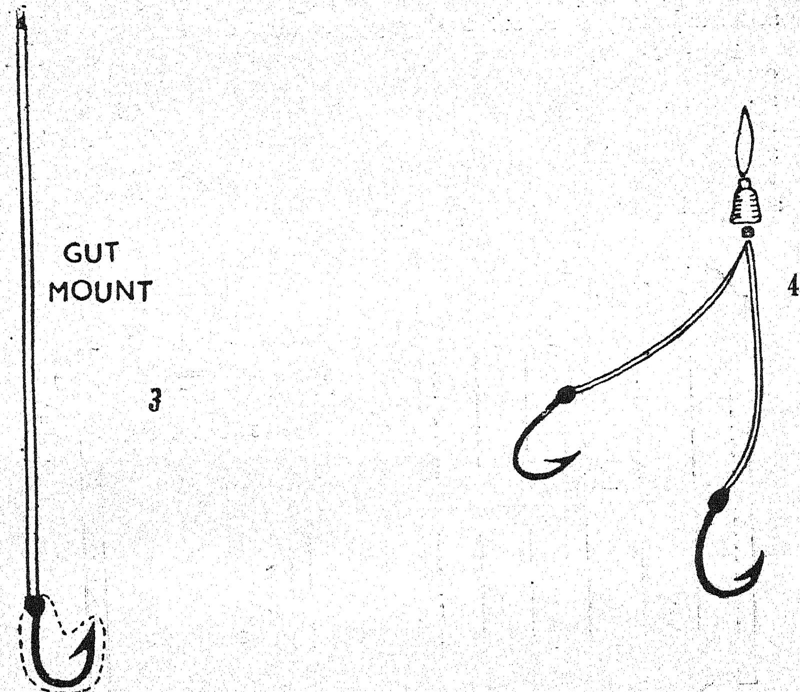


Fig. 64.—Gut mount shelving banks or clear tanks.
Fig. 65.—Two hooks for flat bottom fishing.

the surface of the water the better. A small footway connecting the machan to the bank, should not be attached to the machan, but a small gap left between, so that if an attendant brings any-

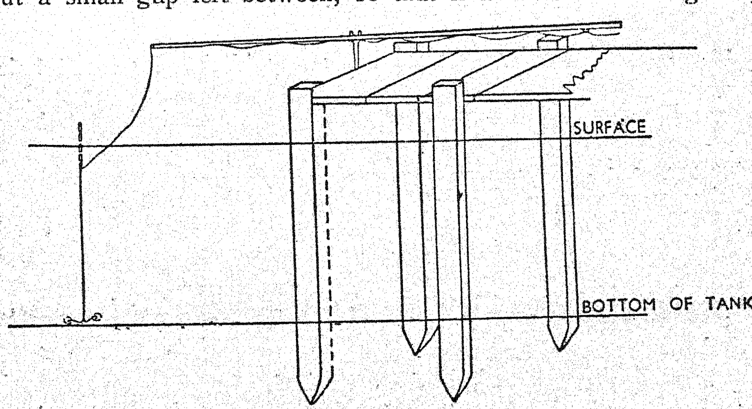


Fig. 66.—Machan showing rod rest, point of rod, float in correct position and directly over bait.

thing along to you, while you are fishing, his movements are not taken by the posts of the machan. A small stool or chair of any kind, and a rod rest completes the outfit, and we are ready to make adjustments of our fishing gear. (See diagrams 66 & 67.)

9. *Depth of water.*—This is the first thing to be done. A careful reading is made of the depth of the water, and the float adjusted to stand vertical in the water. If the bank is shelving one must consider the exact distance each time to lower the bait, and the baited hook must be dropped in directly over, or you will find that the line is not vertical from the float to the hook, a most important detail. (For proof of this see Figs. 66 & 69.)

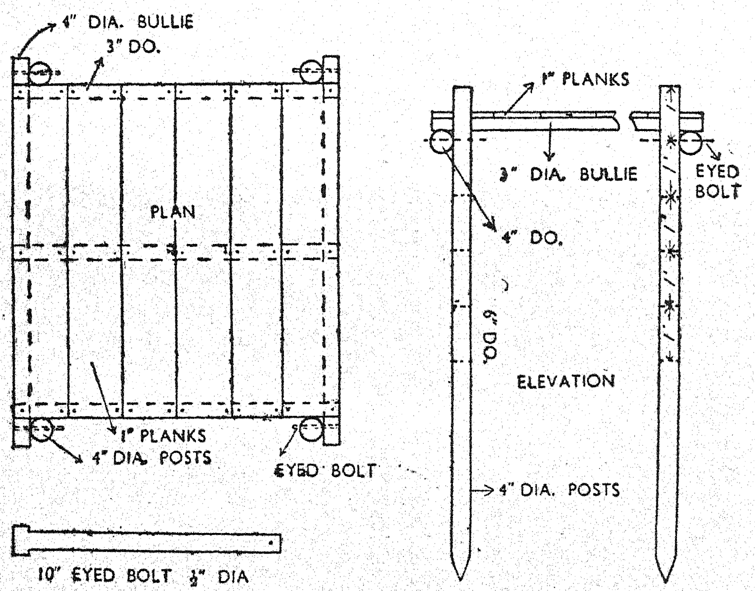


Fig. 67.—Adjustable fishing machan.

10. *Ground Baiting.*—There are many kinds of ground bait; oil cake either mustard or castor, fried or fermented is good. Mix it with mud or gram or atta or rice, and throw it in. A large variety of ground baits can be bought, if one is foolish enough to do so. I myself think, provided the machan is a good one, the bait is a secondary matter, and the best and most pleasant bait to use is roasted mustard cake, mixed with bran, damp earth and water, made up into slabs 4 to 5 inches in diameter, and a couple of inches thick. Mix in the proportion of 2 parts oil cake, 2 parts bran, and one part mud. I say in flat cakes because of the usual practice of making balls. These, if the bank happens to shelve towards the middle of the tank, will roll down and away from your fishing ground, if the cake is hard.

A cone-shaped weight, with a cork strip let in, and a loop at the top, is best, and the most convenient plummet, but any weight will do equally as well. A 'Hillman Lead' for instance.

11. *Method of Fishing.*—The points to attend to then are:—

(1) Ground bait for 3 or 4 days before you attempt fishing, depending on the size of the tank.

(2) If the bottom is soft and muddy, a good dodge is to drop in a few baskets of gravel, and have it settled on the bottom by some local fishermen, Malars or any other of the tribe who can dive, this is a precaution well repaid, and is besides an attraction to the fish. Only 3 or 4 sq. feet of bottom need be prepared in this way, so that the baited hook will not be obscured from view, by sinking into the soft mud.

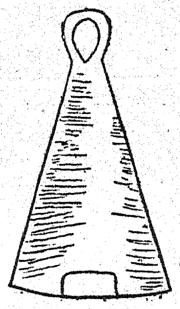


Fig. 68.—Plummet.

(3) Next get the correct depth in a vertical line from your float to the bottom, by means of the plummet. This should be adjusted, so that the float is $\frac{2}{3}$ under and $\frac{1}{3}$ out of the water, or as near as possible, with the sinker just resting on the bottom. (See Fig. 69.)

(4) The float should be as near and under the point of the rod as possible, with the head line reduced to the minimum. This enables one to instantly strike a fish. It will be seen later that this is of great importance. The weight of the baited hook should be greater than the resistance of the float. That is, if the line connecting the float to the bait is less than the depth of the water, the float should be carried under water. This is important.

12. *Bait.*—The usual bait is paste, either flour or atta, or nice red worms. There are many others besides. Adding smelly stuffs to the bait, onion juice, turmeric (huldee), asafoetida (heeng) and numerous others; dried weed powdered and mixed with gram flour is supposed to be good for *Cutla.* Whichever is selected, should be prepared in the manner I have suggested for mahseer fishing, by boiling it a few minutes, when it gets nice and sticky, and will not leave the hook so easily as if it were not so treated. Mixing cotton wool is another dodge, a bait little known is the leech. It is a lively worm and takes excellently, only give a fish lots of time before you strike.

White ants or wasps' eggs are sometimes fancied. The variety of bait used by the Bengali and the Mohammedan would fill a book; let us select from this humble list, one of the few mentioned.

13. *How Fish Bite.*—The idea of so sensitive a float, is to register the slightest nibble of the bait, these fish bite in a very delicate manner. The first indication of the fish at the bait, is that the float moves slowly, either up or down, this being followed by a number of bobs, moving perhaps half an inch in either direction, or even less. Strike when the float is going down, or when the fish is sucking in the bait. The other signs are, float slowly disappears or lies flat on the surface, both are indications to strike, and more satisfactory than the first mentioned. In the second case, the fish has lifted the bait into its mouth and is moving off. A third, is the fish lifting the bait off the bottom, and taking the weight of the sinker off the float by moving upwards. Strike hard.

14. *Striking a fish.*—The more pliable a rod the less chance of breaking your line in a strong strike, which must be sharp and firm, to send your hook home into the tough mouth of the fish, and it must be quick or the fish expels the bait from his mouth, as soon as he feels the drag on the line. Too stiff a rod will cause breakages, which occur in the most mystifying fashion. You strike but do not feel the fish, yet the line snaps. The best way, I think, is to strike off the reel, provided you have a strong check. Do not hold the line against the rod when striking; with sharp hooks a single-handed strike is quite sufficient to drive the hook home.

15. *Playing a fish.*—If possible move away from the machan, so as not to disturb the baited ground. A landing net or an attendant can then fix your fish for you. The Rohu goes off with a strong rush when hooked, and will sometimes jump out of the water. The Mirgil often comes to the surface on being hooked, and remains there a few seconds, before dashing off.

16. *Shelving banks.*—If the tank has a bottom falling away to increasing depth, I have found that the small weight can be dispensed with, and a very light and long float used, say 10 inches. Allow the bait to rest on the bottom, with the float as much out as possible, the object of the large float is obvious, and re-

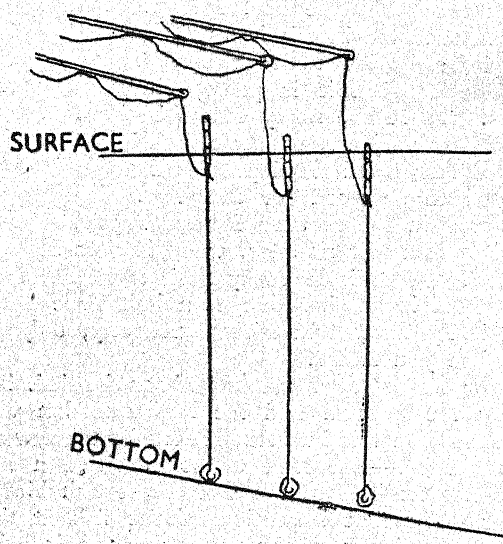


Fig. 69.—Position of float alters with position.

duces the error of exactness in lowering the bait. Frequent striking is necessary, under these conditions, or the bait gets carried down beyond the registering depth of the float. (See Fig. 69.)

17. *Season and time.*—This is a matter of local conditions. In so vast a country as India a general remark is all that is possible. The rains is the best time, when the fish take fairly regularly, almost all day; in the hot weather the morning and

evening at the changing of light, appears to be the best time, from 5 to 9 a.m. and then again from 4-30 to 7 p.m. or until it gets dark.

I hope that this brief description of the methods, aided by the diagrams, will acquaint the reader sufficiently with this form of fishing, and that it will help him to success. They are no mean game, either in circumventing or fight, and well worth an afternoon's sport, for they will steal your bait, and tax both skill and patience to the utmost.

18. Cutla Fishing

The Cutla is to be found in most tanks where one gets Rohu and Mirgil and attains a greater size than either of the two fish just mentioned.

It is rarely caught hooked in the mouth; I have never caught one, though I have fished in tanks where they were plentiful, and attained a huge size.

The methods of foul hooking, used by Bengali gentlemen, who incidently are masters at this form of fishing, are fully described by Mr. Bhattacharyya in his book, and in Mr. Kitchen's Note.

I am indebted to Mr. A. Corbet for the following Note on Cutla fishing, and can thoroughly recommend it to all tank anglers. Mr. A. Corbet has caught more large fish in tanks than any one else I know.

19. Cutla Fishing by A. Corbet

'**Cutla buchanani.** U. P. 'Boassa.'

Teleg., *Botchee, Punj. Taila,. Bom.; Tambra. Behar, Bhakur.,* Hind., *Bing., U.P. 'Boassa.'*

'Usually found in all tanks throughout India. Represented by only one species.'

'Like a carp in appearance, but much more heavily built, and attaining a very large size, sometimes about 100 pounds. Very large head, the length of the fish is usually three times the circumference of the head, broad snubby snout, mouth turned upwards, with no upper lip'.

A bottom feeder, like most other tank fish, and not quite as shy. Often known to take bait within a yard of the bank, in three to six feet of water or deeper. Its nibble is shy and gentle.'

'A spot or "char" should first be selected in the tank, preferably where the water is from 3 to 7 ft. in depth, and the bottom for about 12 ft. out and 5 ft. across be thoroughly cleaned of all grass and weeds, also of all black or ponky, rotted earth, found in most tanks.'

'Liberal ground baiting is necessary, and there are several highly vaunted nostrums for this purpose. A few of the most successful used for attracting most kinds of Tank fish, are—fried mustered oil cake (khulli), teemul, methi, mumgreilla, and jeera.'

'A small portion (about 1 oz.) of each of the last four named ingredients should be fried and pounded, and mixed with reddish earth (Chikna Mutti), the fried mustard cake can either be crushed and added or thrown in whole pieces of about ½ pound in weight.'

'The mixture of earth and ingredients should be made up into small flat cakes, the size of the palm of the hand, and thrown into the fishing "Char".'

'The baited hook should rest on the bottom, where the ground bait has been laid.'

'Tank fishermen are always pestered by turtles, prawns, or crabs. A good method of keeping the first two away from a fishing "Char" is to fill a

bottle straw with any old raw meat or chicken entrails tying up both ends attach a stone and sink about 10 ft. away on any side of your "Char", this will keep them busy most of the day.'

'A handful of "Dhal" thrown around your bait, is useful in keeping away crabs.'

Bait. 'Most kinds of paste bread, boiled flour and atta form preference. Before the monsoon when the water in tanks is low, and not too clean, some honey mixed with the paste bait, preferably flour, which is the whitest bait, is recommended. Cutla seem to be attracted by most highly scented baits, and during the Jack fruit season, a couple of dozen flakes thoroughly ripe, mixed in with the ground bait, is a most successful lure. Slight flavouring of the same fruit, used in the hook bait or paste, adds to its effectiveness. Besides paste bait, cutla and other tank fish will take wasp and bee grubs, maggots, sometimes worms and pieces of raw prawns.'

Tackle. All that is required is a one-piece bamboo rod, fairly 'stiff, with some country silk tussore line, preferably mooga four ply, medium thickness. Special modern rohu hooks, easily obtained these days, and a peacock quill float about 6 inches in length'.

Mr. A. Corbet has not detailed the method of fishing, but this is the same as mentioned earlier in this chapter, for all bottom feeding fish.

I am also indebted to Mr. P. H. Kitchen for the following note on Tank Fishing. Mr. Kitchen is an experienced angler, and sent me besides some very interesting notes on Mahseer fishing in Burma.

His note on the Cutla is most enlightening and the ratio of Cutla to the Rohu and Mirgil he has taken, is better than I have had the good fortune to experience. I have caught scores of Rohu and Mirgil, several over 30 pounds, but never a Cutla, although I have fished in tanks where they were both numerous and large.

20. Tank Fishing by P. H. Kitchen

"With 18 years' experience of tank fishing between Calcutta and Hazaribagh I would unhesitatingly advise the angler who aspires to even moderate success in Bengal waters to study the methods of Bengali fishermen, and with but slight modifications to adopt his ways to theirs. With this word of caution I shall proceed to a general description of tackle required and the method of using it.

Rod.—A plain Ringall bamboo, length 10′ to 11′, never more, stiff in the butt, and with a medium pliable top is the best. When such sophisticated and shy fish as Cutla are nibbling, the strike must be as quick as lightning, and a flexible rod would spell failure.

The first reaction to a sharp strike with a pliable rod is that the point bends downwards and strikes the water and the fraction of a second is lost before the point springs back and tightens the line. This means the loss of the fish. When selecting a rod care should be taken to pick one in which the knots are close together, and of which the outer skin is bright and glossy. These are stronger and quicker, and do not warp so easily as bamboos of which the knots are far apart and of a dull appearance. Linseed, or mustard oil should be rubbed into the rod monthly, and if this is done, and granted a rod has been carefully selected in

the first instance, there is no reason why it should not last for 15 years.

Such a rod mounted by the angler with which fittings and rings would cost about Rs. 3. Tackle shops would charge Rs. 10 to Rs. 15.

Reel.—$3\frac{1}{2}''$ to $4''$ preferably of aluminium alloy. Revolving plate, plain check.

Line.—Cotton and flax lines are inclined to swell in water, and are not as good as undressed, handmade, silk Mooga lines the best quality of which costs Rs. 2-8 per tola. These lines are immensely strong in proportion to their thickness and are slightly elastic.

Gut.—Quite unnecessary. Japanese 'Ja-gut' is all that is required.

Hooks.—Short shank, round bend, needle pointed. Genuine Burdwan hooks are the best. Manton of Calcutta stock hooks similar in shape, but the points should be sharpened.

Float.—A piece of peacock quill 6″ long, one end of which should have painted on it 2 narrow black bands $\frac{3}{4}''$ apart, and the other end furnished with a loop of thin twine for fixing it to the running line. This is commonly known as Thomas 'Detective' float, but was actually in use centuries before Thomas came to India.

Bait.—The first consideration is ground bait.

There are various spices and concoctions, some unmentionably filthy, used for attracting fish, but after considerable experiment I have ruled out all except the following as being essential or desirable:—

(a) Mustard seed oilcake—$\frac{1}{2}$ lb.
(b) Maithee seed—1—oz.
(c) Groundnut—4 ozs.
(d) Yellow clay—1 lb.

Pound the oilcake and roast it in an old frying pan until it smokes slightly.

Grind maithee seed and groundnut separately and roast until of a rich, brown colour.

Mix these ingredients with the clay which should have been powdered in a dry state, add water, and knead to a stiff consistency. Break this mixture into lumps the size of billiard balls, and throw into water $\frac{1}{2}$ an hour before actually fishing, and just where the hook will rest at the bottom.

Hook bait.—From June to end of July during the first showers and when water is discoloured, earthworms are as a rule—there are exceptions—readily taken by Rohu and Mirgal. August to end of October, after which tank angling is useless in Bengal, the bait *par excellence* is 'Maitah' or 'Meotah.' Country liquor in Bengal is brewed from fermented rice, and the residue left over after the liquor has been strained off is called Maitah. This should be squeezed on the hook in a lump the size of a marble, and the line carefully lowered into the water. Maitah is soft and flakes off readily, and this should be borne in mind when a fish nibbles.

16

Depth at which to fish.—This is most important. The hook and a single shot fixed on the snood 6″ above the hook should just rest on the bottom, and the float regulated on the line so that only the bands painted on it appear above water.

Care should be taken to choose a spot where the water is from 3′ to 5′ in depth, and if there are reeds and grasses between the point of the rod and the angler, so much the better. I have heard it advocated that the deeper one fishes the better. This is I think distinctly wrong. Fish, particularly towards evening, are inclined to browse amongst the reeds in the shallows and when the water is discoloured. I have hooked a 36-lb. Cutla in 2½′ of water.

When to strike.—It is usually possible to determine from the behaviour of the float, and occasionally from bubbles rising round it, the species of fish in the swim. A Mirgal sends up a burst of small bubbles, a Rohu fewer and larger, and a Cutla one or two very large bubbles. When a Mirgal accepts the bait, the float after one or two slow bobs sometimes disappears from sight.

A Rohu after several bobs usually raises the float well out of, and sometimes lays it flat in the water. Strike to this movement, and the fish is a gift. A Cutla after one or two bobs twitches the float rapidly. Strike hard and quick, and with luck 70 yards of line will be torn off the reel after which a stubborn fight will follow. On one occasion I saw a Bengali Babu strike and play a Cutla from 3 to 5-30 p.m. during which time the line off another man's reel was brought into requisition. The fish scaled 68 lbs. On yet another occasion I watched a struggle with a Cutla from 4 p.m. to 7 p.m. when eventually the sorely tried hook broke off at the barb and the darkness of night swallowed the profanities of an exhausted fisherman.

As a rule when a Rohu is struck he springs clear out of water and then dashes off at a speed which would seem to indicate an urgent engagement elsewhere. He has not however the Scottish dourness of the Cutla. The Mirgal bores deep, but his first rush is not to be compared with that of the Cutla or Rohu. When fishing in tanks equally stocked with Cutla, Rohu and Mirgal one's proportion of fish taken in a season would be approximately Cutla to every dozen or more Rohu and Mirgal. The Cutla is a finnicky brute, and in spite of his big head and mouth he is the daintiest of feeders and a thief so one must not except to meet very many of these fine fish. The Bengalis have interesting method of fishing for Cutla which I have on occasion seen successful. This method is called 'Char-Kati' and is a poaching dodge pure and simple, but possibly excusable when Cutla of 50 lbs. and more are sucking surface weeds, and no bait however tempting will induce them to accept it.

Strips of bamboo are woven to form a hollow shell, the size and shape of a large cocoa-nut, and a thin bamboo some 6′ in length passed through it. This shell is filled with boiled rice, spices and 'Maitah' after which one end of the bamboo is thrust into the soft mud at the bottom of the tank leaving the other end protruding about 1' above water. The angler then seats him-

self with rod and line to which are attached 2 or 3 hooks very square in the bend and known as Cutla hooks, and watches the end of the bamboo.

When this twitches it indicates a fish nosing around and trying to get at the tit bits in the bamboo shell.

The hooks are carefully lowered until approximately under the fish, when a hard strike may result in it being foul hooked (Fig. 70)."

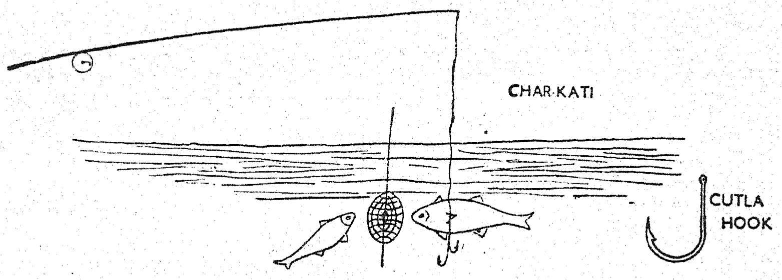


Fig. 70.—The 'Char-Kati' in action.

I have little to add to these notes except to say that a sound knowledge of the Code of the peacock quill, perfect co-ordination of eye, brain and wrist and patience in broiling sun or pouring rain are essentials to success in tank angling. The man who would 'chuck and chance it' had better stick to his spoon and rapid in some brawling Himalayan stream.

CHAPTER XII

ADVICE TO ANGLERS.

Dont's and Do's about Rods (1). Fast Joints (2). Rods when out of use (3). Reels (4). Line Drier (5). Keeping swivels and split rings (6). Keeping large hooks (7). Killin wire (8). Gut (9). Wire for Mounts (10). Spoons made from old pots and pans (11). How to prepare atta or dough (12). Dressing lines with tallow (13). Dressing sea lines (14). Keeping dressed lines (15). Treating tacky lines (16). Rod and tackle varnish (17). Cobblers' wax (18). Steadying a boat. (19). Releasing hook hold in rapid water (20). How to weigh Giant Fish (21). Weighing fish with two or more scales (22). Calculating the weights of fish (23). Picking dead bait (24). Catching live bait (25). Determining the age of fish (26). Spikes for boots (27). Leeches and ticks (28). Maps (29). Rod cases (30). Clearing drinking water (31). Trophies of fish (32). Catching frogs for bait (33). Biting flies and how to evade them (34). Soldering Traces (35). Marking fish (36). Poaching (37). Butterflies (38). To soften butterfly's wings (39). Fish displaying temper (40). Record Mahseer (41). Thermometer (42). Photography (43). Formalin (44). Borax (45). Tackle Boxes (46) Fishing stools (47). Best Books on Fishing and Sport in India (48). Newman & Co. Calcutta (49). Sealing Wax (50). Enamel Paint (51). Packing and carriage of fish (52). Protecting flies from the ravages of insects (53). Dying Gut (54). Manufacture of Silk Worm gut (55). Knots for tying Gut, Flies, Hooks and Lines (56). Nylon for Casts (57). Garters (58). Ankle Puttees (59). Sore Toes and Feet (60). Sun Burn (61). Glare Glasses (62). Topee (63). Jacket (64). Tackle Outfit (65). To Skin and Preserve a Mahseer (66). Medical (67). Medicine (68). Wounds (69). Foul Hook (70). Bleeding (71). Blisters (72). Boils (73). Stings. Scorpion Stings (74). Septic Wounds from Tiger and Panther (75). Fever (76). Drowning (77). Addendum to Chapter 'Scraps from my note book' (78). Hardy's gut, wire, hooks etc.

1. *Don'ts and Do's about Rods.*—Don't put a rod away in a damp cover, or tops in damp cases. Don't use vaseline or oil on rod ferrules; tallow, raw mutton fat, or soap are the best lubricants. Don't tie rod cover tapes tightly when putting a rod away for any length of time. Don't hold the wood, or cane when putting a rod together; grip the metal ferrules in turning the rod joints or when pulling them apart.

Get your rod overhauled at the end of a season, or coat it over with varnish yourself; it will give you endless service if you do.

2. *Fast joints.*—If, as so often happens, ferrules get stuck a good tip in the first instance is to get two pieces of rubber (the inner tube of a car or motor cycle cut up does excellently), and wrap them around the joints, this will give you a good purchase, and will generally work the deed. Should this not prove successful, then heat the ferrule with a candle flame (BUT WELL AWAY FROM THE LASHING), until it is too hot to touch, pour cold water over the joints when with the aid of the rubber it should come away. In case of an extremely tight joint a small pair of gas pliers will grip one socket without damage, and so enable the most obstinate of joints to be drawn apart.

3. *Rods when out of use.*—Hang up rods when not in use on a wall free from damp, and in a room that is in constant use, your dressing room for instance, so that they can be frequently looked over. Be careful to keep the plugs in, or a 'mason wasp' will plug it for you!

4. *Reels.*—Keep nuts and screws tight while in use, and look them over daily, or better still, after each run by a fish. One small screw lost, may put the whole reel out of action for the trip, unless you have spares. It is the hardest worked item of the outfit, and one which tackle makers have much to learn about and improve. Carry spare springs, ratchets and screws.

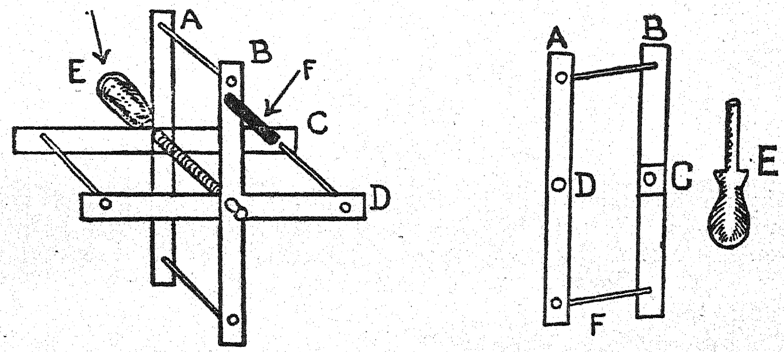


Fig. 71.—Line Drier.

5. *Line Drier.*—The four sides A. B. C. D. come apart, also the 4 stays connecting A. & B. and C. & D. When built up as in sketch, the handle and spindle E. is put through and keeps the frame together by a pin through the hole at top end of spindle, the handle is held in the left hand and the small handle F. on B. is the winding handle. Line can be cleared off a reel in a few moments. The size of the arm is 18 inches and width 6 inches. A. and B. are dove-tailed to take C. and D. inside at point of intersection. Many other forms are also offered by tackle dealers.

6. *Keeping swivels and split rings.*—I have found the best and most convenient way of keeping all small gear, like swivels, split rings, small hooks, etc., is by making use of small bottles and tins, putting them into these with oil. They keep for ever and save many a disappointment.

7. *Keeping large hooks.*—Hooks, and large or small trebles, keep best put into a tin with grease and the lid closed down. They are an expensive item and worth this additional trouble.

8. *Killin wire.*—Killin wire for traces, unless kept well oiled, will rust and many a spoon will be lost. This can be avoided by wrapping a small strip of flannel dipped in oil around the reel of wire.

9. *Gut.*—Gut kept in flannel dipped in glycerine, will keep fresh, and will last for several seasons.

10. *Wire for Mounts.*—Cheap galvanised wire procurable in any bazar, or off a whisky case, makes excellent mounts for large spoons. (See chapter V, under 'Tackle').

11. *Spoons made from old pots and pans.*—Old cooking pots of copper, aluminium, or brass, make up into most useful spoons. These can be made up in any bazar at a quarter of the price one has to pay in tackle shops.

12. *How to prepare atta or dough.*—The best way to prepare atta, so that it sticks on one's hook in running water, is to have it first kneaded into a fairly thick mass, wrap a piece of fine cloth around it, then put into a pot and boil for a few moments, in this can be included any fancy smelly ingredients. Take out and knead until it is sticky and soft.

13. *Dressing lines with tallow.*—Plaited lines dipped in melted tallow make excellent spinning and casting lines. Coil the line into a convenient sized pot, with enough tallow to cover the line (a couple of tallow candles), when the tallow has melted, dip the line in for a couple of minutes, or until the tallow starts setting. Take the coil of line out, and with a flannel rag work a couple of yards at a time with the fingers, until it gets warm to the touch, move on to the next couple of yards and so on. This will give you excellent results, as it prevents the line swelling and does not rot the line. The more work you put in with the fingers the better is the result. Another good dressing, which also floats a line, consists of one ounce clean bees wax and one ounce (liquid measure) vegetable oil. Warm the bees wax and mix; treat line as for tallow dressing.

14. *Dressing sea lines.*—Stockholm Tar 2 ounces, methylated spirits 20 ounces, dissolve until well mixed. Coil line in a wide mouthed glass jar, pour in the mixture. Keep jar tightly closed for 48 to 60 hours. Then remove line and hang up to dry. Mixture will keep and can be used again. Sea lines, whether dressed in this way or not, should every day be washed in fresh water after use.

Synthetic resin glues, one of the discoveries of the War, form a bond of enduring strength, and is used in its different formulas to bond metal to metal or metal to wood or wood or metal to rubber, etc. It is as yet in its infancy so far as the household uses are known, but of its efficiency we may only look at the Mosquito, one of the best kites in the air today; all wood and bonded by this synthetic discovery. Here are some names to keep in mind, and watch out for their commercialization.

PHENOL-FORMALDEHYDE GLUE, Champion of all in waterproofing qualities, is derived from phenol which is carbolic acid. It has stood six years of soaking at the Forest Products Laboratories in the U.S. and showed no more deterioration than the wood it joined. Once set no amount of heat can melt it. Other names to keep in mind are MELAMINE, UREA, RESORCINOL, and FURANE.

But the glue that is likely to prove the Angler's friend is PENACOLITE G 1131 and CASCOPHTEN RS 216. These are made by the Pennsylvania Coal Products Co., Petrolia, and Casein Co., of

America, respectively. Both these phenolic-type resins set without heat, which is of the utmost importance as it permits of use without access to special equipment found only in factories. It brings its use within the scope of the layman and amateur craftsman. This glue is a liquid that will set at room temperature—from 75 degrees F. upwards after the correct catalyst is added. It is claimed to be far superior to cold-setting UREA resins that have been in wide usage for several years. Not only is it more waterproof but it requires less critical technique in handling. It remains immune to heat, humidity or wetting (a consideration in the varied Indian climate).

CYCLEWELD made by Chrysler Motors and PLIOBOND made by Goodyear Tyre and Rubber Co. are two of the better known compounds used for bonding rubber and wood or metal.

REANITE, METLBOND, and REDUX are other adhesives of that type. Synthetic resin glues are turned out as powders, liquids, emulsions, and films. Cold-setting resin powder of the UREA type is sold across the counter and available in hardware and paint stores. It is used by mixing with water.

Cold-setting phenolic liquid is expected to be offered to the general public in small packages shortly in America.

There must be the equivalent in as many makes in England or Britain but I have no details. Rod makers of repute will be closely interested, and quick to take advantage of this new discovery.

15. *Keeping dressed lines.*—An aluminium cigar-drier makes an excellent jar for keeping dressed lines, likely to get tacky, or in fact for any lines during the monsoon.

16. *Treating tacky lines.*—Most waterproof lines, so excellent in the English climate, get sticky and tacky out here, in a season. This can in most cases be cured in 'Lime Water' (sold by all chemists).

Put the lime water into a wide bowl or cooking pot, then put the tacky line in, coil by coil, so that it does not adhere, and prevent the liquid getting to parts on the surface. Allow it to soak in this over night or longer (it does not damage the line), take the line out, remove as much liquid from the line, as you can, and hang out in a shady spot to dry. It is a good thing when dry to rub the line over with Ceroline or any animal fat. This should restore the line to its original texture.

17. *Rod and tackle varnish.*—Shellac and spirits of wine make an excellent varnish which dries soon after use. Shellac can be purchased in flake form in most bazars. Put flakes into a bottle and add spirits to give the required thickness. It melts in a couple of hours and no further treatment is necessary. Turpentine varnishes are also excellent, but take longer to dry. Cutex nail polish also makes a good varnish.

18. *Cobbler's wax.*—A mixture of equal parts of bees wax, lard and turpentine, make an excellent cobbler's wax.

19. *Steadying a boat.*—A good tip when only a light boat is obtainable, is to tie two or more large bamboos on either side along the whole length of the boat, they have a most steadying

effect and prevent the boat rolling or taking in water while shooting a rapid. This is practised by the Shans and Kachins with good results in the upper waters of the Irrawaddy.

20. *Releasing hook hold in rapid water.*—The spoon is often caught up in snags and rocks in a rapid where a boat cannot go. A good dodge is to attach the line to a piece of bamboo or small forked branch by a running loop. Get above the spot where you are hung up, and release the bamboo, so that it will pass over where you are snagged. Give plenty of line, and as often as not, when the bamboo passes over or gets below where your hook is fast, it will come away. An excellent tackle release—vouched for by a correspondent who has used it a great deal, is a three-quarter inch piece fairly hard wood four inches in diameter, with a bevelled hole through the centre, this hole big enough to allow largest sinker used to pass through. Outside edge of disc should be rounded and the wood be sand papered and painted white. The disc is slipped on the line by means of a V slit cut to centre hole and stopped by a smoothly and accurately fitting wedge. The disc on reaching the water works its way to where the bait is fast and the action of the water releases the hook. It 'works' in most cases, but not, of course, if the hook is in a 'snag'. Cost is nil, it is nearly always recovered as when a break away has to be made it floats and can be chased and collected by an attendant. It is worth its weight in gold as a saver of tackle.

21. *How to weigh giant fish.*—Cut two bamboos of equal length A. and B., fix them in the ground so that they give you a clearance of a foot at least, above the length of your fish. Slot these bamboos to take a third across C. Now mark off the centre of the bamboo C, and from here suspend your fish. With spring balance hook on one end, lift bamboo C and as soon as it moves take your reading.

This doubled will give you the weight of your fish. I have tested this method and found it works out exact with weighed fish. It would only be used on fish with greater weight than your scale registers.

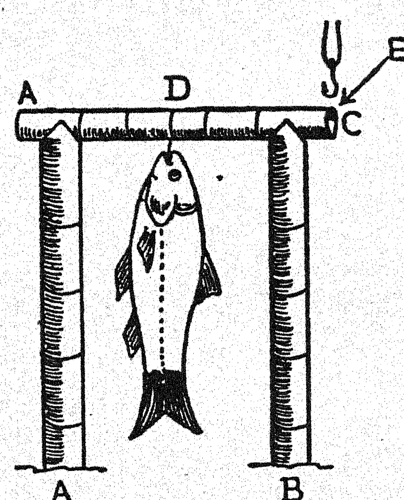


Fig. 72.—Weighing giant fish.

22. *Weighing fish with two or more scales.*—The following is from the *Rod in India* and is produced here for information.

'When I bought my fishing tackle, I thought a spring balance weighing up to 32 lbs. was big enough for any man. But one fine day I had the misfortune to catch a mahseer well over that weight, and, of course I was particularly anxious to know its exact weight. I had in camp two spring balances

weighing respectively up to 28 and 32 lbs. I passed a stout cord through the rings of the two, and suspended them from above. Then a cord attached to the fish and passed over the two hooks suspended the fish simultaneously from them both. Reading off the weight indicated by the two instruments and adding them together, the result was the weight of the fish, 46 lbs. If neither of the springs is pulled down beyond its power of springing, the total is bound to be accurate. I have tested it.'

23. *Calculating the weights of fish.*—By the common formula laid down in "The Angler's Hand Book", I have not found this work out consistently on the large fish. I have reproduced here four examples, in which only one is really anywhere near correct, still if no other means are available, it gives the approximate weight.

Examples.

$$\frac{\text{Length and one-third length} \times \text{Girth in inches squared}}{1000} = \text{weight}$$

of fish.

Rivett Carnac's record mahseer of 119 lbs. was 64 inches in length and 42 inches in girth. Example:—

$$\frac{(64 + 21) \times 42^2}{1000} = \frac{149940}{1000} = 149. \quad \text{30 lbs. in excess.}$$

My three best fish, all healthy and game, work out as follows:— Weight 75 lbs. Length 50 inches, girth 34 inches, according to formula works out to 72 lbs. Three pounds short of actual.

Weight 50 lbs. Length $56\frac{1}{2}$ inches, girth 28 inches, works out to 58 lbs. 8 pounds in excess of actual.

Weight 44 lbs. Length 52 inches, girth $26\frac{1}{2}$ inches, works out to 48 lbs. 4 pounds in excess of actual. It is stated to me by a correspondent that such a formula is accurate to a pound if the measurement of length is to *fork* of the tail and one quarter and not one-third is taken e.g. $\frac{L+\frac{1}{4}L \times G^2}{1000}$ is a good formula. Brother Anglers may try it out for themselves.

24. *Pickling dead bait.*—Before inserting in the formalin solution, cut off the fins, all except the anal fin. When the fish begin to stiffen in the solution, the required sideways bend should be given to the tail: some to right: some to left. This bend cannot be given after the fish are stiff. Only actual practice will teach the angler the correct strength of formalin to use. If too strong the fish will be white; the weakest solution compatible with preservation will give the best results. The following two recipes for preserving minnows as spinning bait, are taken from the *Fishing Gazette,* with acknowledgments:—

1. 'Kill the minnows in a solution of formalin and water. In 24 hours or thereabouts, wash the minnow under the tap, in order to take as much of the smell of formalin out as possible, then place them in a wide-mouthed jar. Dissolve sugar and water and pour it over the minnows, leave the lot exposed to the air; in a week or so smell the minnows to see if the formalin taint has disappeared; sugar and water in which they are may be kept for months. Glycerine is all excellent and better than sugar.'

2. 'Minnows preserved for use as spinning bait should be free from the smell of preservative. Salted specimens are good, but not so well suited to the purpose as those prepared by the following method. Formalin as sold to the public is acid and for our purpose should be non-acid. The necessary change can be effected by adding a pinch of baking powder to an oz. of formalin. Keep the minnows alive for 48 hours in a basin of water to which has been added a teaspoon of common salt; this will reduce the size of their bellies. Kill by a flick on head with finger nail and place in a bottle to be tightly closed (Prune jar excellent) in which is: distilled water 99 parts, non-acid formalin one part. After a few days change the solution. The fish will keep for a long period. When required for use remove any smell of formalin there may be, by washing in salt water; and if possible, to make quite certain, mix the prepared minnows with fresh ones and all smell will disappear. If the baits are large, they can have a bend given them to assist spinning. This bend they will retain.'

About a dessert spoon full of formalin to a pint of water is enough for small baits. The more formalin, the more difficult to get rid of the smell; so use it as weak as suffices to preserve the minnows in the first instance. The sugar solution should be weak, merely a thickish fluid, the formalin makes the minnows tough and if too strong, turns the eyes white, and takes the colour out of the fish. If the sugar solution is too strong, it is apt to shrivel the bait. The minnows are not ready to transfer to the sugar and water until they are firm to the feel, and rubbery to the touch. Sometimes a scum comes on to the top of the sugar solution, but this does not matter and is caused by not completely covering the fish with the solution. When required for use, a few fish can be taken out, washed, and carried in a tin box, surplus minnows being returned to the solution at the end of the day.

Several fish can be killed on the same minnow. The formalin solution should be 2 per cent or one part formalin to 49 parts water.

There are other ways too of pickling dead bait, but I think the latter of these two is the simplest and the most convenient as well as the best.

Taint of preservative of any kind will be removed from prepared baits by smearing them with Pilchard oil (doubtless Sardine oil equally effective)."

—*Fishing Gazette* 6-8-1921.

Another method of preserving fish, is to place the *chilwa* on a board with the tails curved by means of pins. These are then painted with a strong solution of formalin (3 teaspoons formalin to 2 tablespoons water). After ten minutes the baits are absolutely set, and are then placed in a jar containing two tablespoons of formalin per pint of water. In three days the baits become rubbery and hard. Once the baits have become saturated with formalin, they can be carried dry during a fishing trip.

25. *Catching live bait.*—In a running stream, if you are unable to catch small fish for bait, a useful tip is to dig a small channel a few inches across and a couple of inches deep, and connect it a few yards above into a small pool where fish can be seen. In this run put some atta, tied up in a cloth so that it runs down mixed with the water. This should be done at night. Early next morning, the channel should be closed at both ends; you will be unlucky if you are not provided with bait for that day. It is not always possible to dig a channel. If there is a fall, erect a small platform with cloth or fine net and arrange your atta in the same

way, so that it washes through to the pool below. The small fish will jump to get up to better feeding, and get caught on the platform. It should be erected low enough to catch jumping fish, but should not hold water, or they will jump out again. This method can also be applied from a boat, by erecting your trap over one side, and holding a lantern on the edge. Fish have a strong curiosity for lights. If no suitable small stream is near by, and there are only large pools, get a basket and cover it over with a fine cloth, lower the basket into the water until it is covered by about ten inches of water, in it should be put rice atta or any other suitable bait. Make a few holes in the cloth so that the bait can run out and fish go in. Fish find their way in and get trapped.

26. *Determining the age of fish.* (From the *Scientific American*):

'The age of a fish can be determined with accuracy by inspection of the otoliths or bony concretions, which are found in the auditory apparatus. The otoliths increase in size during the entire life of a fish, each year adding two layers, a light coloured one formed in summer and a dark one formed in autumn and winter. The alternate layers are sharply contrasted and very distinct, so there is no difficulty in counting them. The number of pairs of layers is equal to the number of years a fish has lived.'

27. *Spikes for boots.*—Whiteaway Laidlaw & Co., Calcutta, sell excellent screws for boots called 'Plus Four Screws'. Rowe & Co., Rangoon, also stock excellent studs sold with a punch and screwing device complete. A very handy and cheap addition to one's fishing kit.

28. *Leeches and ticks.*—Never pull off a tick or leech, one is seldom without matches and an attendant. Burn a leech with the flame of a match, by holding its body away and applying the flame, it will at once leave go. For a tick, too small to burn, heat a pin point and touch with it. Here are one or two suggestions as a precautionary measure against these pests. When there is no wading to be done, a strong infusion of tobacco leaves with addition of salt is effective, and does equally well for master and his bare legged followers. Wear two pairs of stockings woollen below and a pair of cotton stockings soaked in the mixture above. The wearing of a high spat well damped in kerosine and worn over woollen and cotton stockings, as above, will keep off leeches, whether you wade in water or not. Kerosine must not get to the skin or blistering will result.

A sure preventative against tick bites is.—Cocoanut oil 90 parts, eucalyptus oil 10 parts. Anoint the whole body neck to toe, before dressing. Ticks may crawl, but they won't bite. (You can decide for yourself which is preferable tick bite or this oil bath!)

29. *Maps.*—Whenever undertaking a trip into unknown country, a large scale map of the locality is of great value. One is able to mark in good spots, letter runs and rapids, which serve with notes for any future trip. These are obtainable from the Government Map Depot, Wood Street, Calcutta, at a very nominal charge.

30. *Rod cases.*—A cheap and most serviceable rod case can be made up from the large hollow bamboos that are common in Burma and India. Cut a section from one of these, long enough to take

a rod leaving a knot intact at one end. From the other end, burn or cut out the knots, and have a leather cup fitted with strap and buckle. If this is not possible cut the length of bamboo in half,

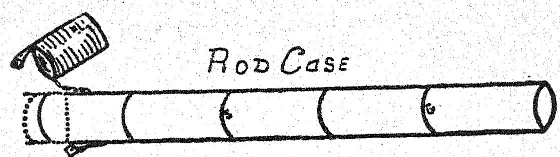


Fig. 73.—Rod Case.

cut out the knots and bind together again, with the same fitting as in the first case. See diagram.

31. *Clearing drinking water.*—If one is dependent on the river for drinking water, and it should come down in spate, a pinch of alum put into a bucket of discoloured water will soon clear it. It is a handy commodity to have by one, being an excellent preservative for skins. Or you can dig a hole some feet away from water's edge and obtain reasonably filtered water.

All drinking water should be boiled: but on occasions when this is not possible one drop of tincture of iodine of seven per cent strength to a quart of water: and the water then well shaken: will, in 20 or 30 minutes, kill all the harmful bacteria that are likely to be there. The amount of iodine added is too slight to even taste.

32. *Trophies of fish.*—The gill plates and teeth of large mahseer make good souvenirs. They can be made up into a quaint mascot for a car, or mounted on a shield. Scales make useful luggage tickets, and menu cards, but are a temptation to the souvenir hunter.

33. *Catching frogs for bait.*—Frogs are curious little creatures and if one dangles a piece of rag tied on a hook above them they will surely jump to catch it, in this way you can fill a pot, should you want them for bait. Most predatory fish relish frogs. The green and yellow, or brown, are the best. Do not confuse frogs with toads.

34. *Biting flies and how to evade them.*—Citronella or Flit, keeps off the many varieties of biting flies met with in the densely forested areas, particularly in Burma and Assam. Smeared over the knees, hands, and neck prevents much discomfort and misery. These liquids are evanescent. Citronella mixed into white vaseline (as done by the Forest Dept.) forms an unguent which has lasting effect.

35. *Soldering Traces.*—'Tinol' is an excellent soldering paste for securing the ends of wire. A little applied to the end of wire and passed through a lighted match sets it firmly, causing no damage to the wire. The 'Britinol soldering outfit' or one of similar efficiency, is essential to an Angler.

36. *Marking fish.*—This is unfortunately little practised out here, because of the size of rivers and a shifting community. Where ever it is possible, as in the case of fishing clubs, marking of fish should be introduced, as it gives most interesting results. A

simple method is with a small brass or copper foil plate, $1\frac{1}{2}$ inches long by $\frac{1}{2}$ an inch wide fixed to the dorsal fin by thin copper wire with distinguishing letters, and a note made in the fishing book at the club or fishing hut. (See diagram.)

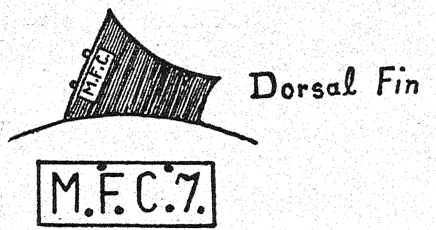


Fig. 74.—Method of marking fish.

37. *Poaching.*—The Burman is an adept at poaching. The cleverest thing I witnessed in this line was by my servant. If a jungle fowl called, he would go into the forest as near as possible to the cock, sit concealed in a bush, and utter noises like a hen scratching and feeding, he accompanied this with a most original clucking noise. Frequently the cock would come to investigate, when he would shoot it. He kept me provided in this way, though most of them were tough patriarchs. In Ceylon, jungle cock are enticed in a similar way by a handkerchief loosely held and brought together by the hands to make a 'clapping' sound, taken by the cock to be the challenge of a rival.

38. *Butterflies.*—A small net for catching butterflies, is a handy and useful addition on a fishing trip. On the odd day when the river is coloured and fishing not possible, a few hours can be well spent gathering a variety of butterflies. Small paper packets for preserving specimens can be made up from greaseproof paper; and even though not up in the scientific names, you will find lots of people who will be pleased to take your collection. Burma has some beautiful specimens, which if set and arranged in a case make a useful ornament in the home.

39. *To soften butterflies' wings.*—Take a tin of convenient size one inch deep, and fill it with saw-dust, then place a sheet of damp blotting paper soaked in a solution of water, with a few drops of Carbolic acid, this is added to prevent moulds which otherwise grow quickly. Put the dry insects into the tin and keep for six hours, or until the wings are moist enough for setting.

40. *Fish displaying temper.*—I saw a fish display what one would reasonably describe as temper. This was in a stream, in Burma, a few yards from my bungalow. I had some 200 mahseer collected from 4 pounds down to a few ounces, where I used to feed them daily under a large concrete bridge. They were protected and no fishing allowed. The stream was no more than 6 yards across and 4 or 5 feet deep and crystal clear. They made an interesting study. It was here that I saw a fish of $2\frac{1}{2}$ pounds clear the hole of some 60 or 70 large fish. The trouble arose when I put in a short hand line with a fly spoon to catch a fish or two for purposes of marking. This fish broke my line and the small Mother-o-Pearl spoon could be seen distinctly hanging from the fish's mouth. Any fish that came near it was chased. The whole performance was clearly visible and most amusing.

41. *Record Mahseer.*—From *The Field* dated 11-1-1920, by Mr. Van Ingen:—

'Whilst fishing on the Cauvery last Christmas, with Mr. P. F. Bowring, D.C., Mysore, Col. J. S. Rivett Carnac and Major C. Jackson, V.C., I had the pleasure of witnessing the capture of the largest mahseer ever caught on rod and line in India. This mighty fish was caught by Col. Rivett Carnac on December 28th, 1919, and was of the following measurements, weight 119 pounds; length 64 inches; girth 42 inches; tail fin 20½ inches; circumference of mouth 26 inches. Previous to this, the record mahseer caught in India, was 104 pounds, caught in 1906 by the late Mr. C. E. Murray Aynesley, at the junction of the Hutty and Cauvery rivers in Coorg, and the largest fish (other than the mahseer was a 112 lbs. Goonch). I feel sure that many years will elapse before the Colonel's record is beaten.'

'This 119-pounder on being hooked, put up a tremendous fight, running out about 125 yards of line in her first rush (so characteristic of the mahseer), and had she kept on straight a break was inevitable, hardly 5 yards of line remaining on the reel, but fortunately for the fisherman she turned and made up stream, and the Colonel was able to recover line. After that the fish made several other big rushes, but there was line to spare. I was keeping time, and it was 25 minutes before we got a glimpse of her, and finally, when she was gaffed by Mr. Bowring and drawn ashore, the excitement was so great that I quite forgot the timing. The average for 1,600 lbs. of mahseer caught this season, works out at about 4 lbs. a minute, so the 119-pounder must have taken half an hour or more. This old hen-fish had a huge hog back, and her body almost cylindrical in shape and must have seen many monsoon floods; and, judging from the age of sacred fish in Mysore, she must have been 200 years old. Major Jackson hooked a fish immediately after this big one was landed, and in almost the same place, probably her sister. This fish ran out about 160 yards of line, and after two hours' hard work got round a snag and broke. The scale used for weighing this mahseer registered only up to 112 lbs, and we were obliged to cut the fish in two pieces and weigh both pieces separately; consequently some blood was lost in this operation, and the fish had been in the sun and wind for three hours before weighing. Yet with all this, the actual weights registered, totalled 119 lbs. I am sure had we suitable scales, the fish immediately after capture would have been 120 lbs.'*

In contrast to Mr. Van Ingen's account, I reproduce Mr. Lacey's fight with a 61-pounder at Tangrot, from *The Angler's Hand Book*:—

'This last fish the biggest on record in the Tangrot Angler's book up to the present, was hooked about 9-30 A.M. He rushed all my line out, 140 yards, just as I landed from my boat, and was pulling dead on the knot. I ran on, but fell in the mud, when my boatman Rokundin, to whom great praise is due, seized up the rod, and rushed into the water, the fish now making straight across the water for the "big rapid". Most fortunately Deputy Surgeon-General Collis' boat was following mine, and getting into it, we followed the fish down the rapid, at a frightful pace and at one time must, I believe, have passed the fish, the 140 yards of line being loose in the river, but providentially it caught in no rock, and I found the fish on when I landed below. Two or three times he had taken all the line out, and was pulling dead on the knot; but by a miracle nothing broke. The fish took to sulking, and for fully 3½ or 4 hours, I hung on to him, but could not move him. At last at about 2 P.M. he gave in, and I landed him. A female fish 4 ft 7 inches in length, and 2½ ft in girth, weight 61 lbs. Caught on a 3½ inch silver and brass spoon and treble gut trace.'

42. *Thermometer*.—A small thermometer is a very useful article to include in one's kit, as the study of the temperature of the water is a very big consideration. Note down what it is when fish are well on the feed, and when not. We have lots to learn about the almanac of fishes, and their feasting and fasting days.

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* Mr. Van Ingen has since claimed to have caught one of 120 lbs. in May 1946.

43. *Photography.*—If developing in hot weather, when the temperature of the water is warm and likely to melt the dressing of a film, first of all wash in a solution of formalin 4%, this fixes and hardens a film and is a certain cure.

44. *Formalin.*—Formalin is the angler's friend, being useful for so many purposes. The collection of small fish as specimens, is a very simple matter and gives little trouble. Requirements: A bottle of formalin (formaldehyde) as sold by chemists; a coil of Zinc foil; a reel of thin copper wire; two wide mouthed bottles (Prune Jars); one or more empty two-pound biscuit tins.

The specimens should be washed in clean water, after making as small a cut as possible in the belly, to remove intestines, and wiped dry. Then place in a bottle containing clean boiled water (cold) 20 parts; formalin 4 parts. After a few days change to the other bottle, in which there is similar lotion. Then remove to the biscuit tin, wrapping each specimen in a piece of linen soaked in the solution, and pack after the manner of sardines. Specimens should lie straight, and therefore not be longer than the biscuit tin. Each specimen before going into the first bottle, must have attached to its tail (by passing a piece of wire through the fleshy part), a ½ inch square zinc label numbered, to correspond with entry in the note book in which are the following particulars:—Serial number, locality latitude, name of rivers, stream or lake, local name of fish, size to which said to grow, nature of stream or water, food, habits, etc., any remarks.

A copy of entries goes with each tin, which is soldered down and despatched by registered post to 'The Curator of the Bombay Natural History Society, Bombay.'

At the commencement of the collection, the strength of the solution should be watched and increased if necessary, for good preservation. The nose will test this, care should be taken to use as weak a solution as is compatible with proper preservation; for strong solution causes too great a change in colouration.

Meat painted with it will keep longer in the heat. Fish can be preserved for specimens for museums. Dead bait can be preserved for months in it; it is a very handy thing to have by one. See under (24) ante for removing formalin taint.

45. *Borax.*—Obtainable in any bazaar. In warm weather wrap your butter in a piece of muslin dipped in 2% solution of borax, and it will remain hard.

46. *Tackle Boxes.*—Allahboy Vallarjee, Multan, makes up excellent tackle boxes. They are strong and last for ever. It is the best tackle box I have seen, and costs with two trays Rs. 30/-.

There is no better tackle bag than the British troop's webbed haversack, obtainable on payment from the Quarter Master's stores of any British Regiment.

47. *Fishing stools.*—The ordinary 'Mora' made from the tough grass common in India, obtainable in most towns for a few annas, adds much to one's comfort while fishing from a boat.

48. *Best Books on Fishing and Sport in India*:—

1. **'The Rod in India'** by H. S. Thomas, published 1897. Undoubtedly the most complete book ever written on Indian fishing.

2. **'Tank Angling'** by the same author, has useful information for the beginner.

3. **'The Angler's Hand Book'** by G. H. Lacey, published in 1905. Has a number of maps of good localities, and deals chiefly with the north of India.

4. **'The Angler in India or Mighty Mahseer'** by Skene Dhu, published in 1923. Has 400 pages devoted to localities all over India.

5. **'Hints to Amateurs in Tank Angling'** by P. N. Bhattacharyya. This is the best guide I know on this form of fishing.

6. **'Game Fishes of Bombay, The Deccan and Neighbouring District'** by Sir R. Spence and S. H. Prater.

Besides these books there are certain clubs that have magazines issued quarterly or annually, dealing with local areas or provinces. Chief among these are:

(a) 'The Nilghiri Fishing Association', Ootacamund, South India.
(b) 'The Dehra Dun Fishing Association', Dehra Dun, U.P.
(c) 'The C.P. Angling Association', Jubbulpore, C. P.
(d) 'The Myitkyina Fishing Club', Myitkyina, North Burma.

Other general books useful on a fishing or shikar trip:

(a) 'Identification of Indian Butterflies' by Brig. W. H. Evans.
(b) 'Identification of Poisonous Snakes' by Wall.
(c) 'The Book of Indian Birds' by Salim A. Ali.
(d) 'Popular Handbook of Indian Birds' by H. Whistler.

Big Game and Shooting books:

(a) 'Wild Animals in Central India' by Dunbar Brander.
(b) 'Big Game Shooting in the Indian Empire' by G. H. Stockley.
(c) 'A Game Book for Burma' by E. H. Peacock.

49. Newman & Co., Calcutta, in 1919 made up for me an excellent Log Book, 9½ by 8½ inches of strong paper and bound in leather. Small leather tags show different compartments, the left hand sheet ruled off in manner shown on specimen, the right hand sheet left blank for notes. Under the four headings:

Fishing. Small Game. Big Game. Pig Sticking.

50. *Sealing Wax.*—A few sticks of Sealing Wax in various colours are handy for painting spoons. These dissolved in spirits of wine make the best paint for spoons.

51. *Enamel Paint.*—Good enamel paint is available in most Indian bazaars and is sold in convenient sized tins. They cover a wide range of colours.

52. *Packing and carriage of fish.*—Directly a fish is taken out of water, it should be killed, disemboweled and cleaned (not with water), with a bundle of grass or dry cloth. The inside should then be sprinkled with charcoal and salt alternately. Oil rubbed over the inside surface is also used. In England stinging nettles are much used for packing fish, it greatly preserves the bloom and freshness.

53. *Protecting flies from the ravages of insects.*—

1. Napthaline crystals efficiently protect Salmon flies from insects. Fill a small pill box with powdered crystals, then cover over with a double layer of muslin instead of the lid, and place with

FISHING

DATE	LOCALITY	FISH	WEIGHT	GIRTH AND LENGTH	BAIT AND TACKLE	REMARKS

NOTES

the flies. The crystals must be replenished every few months, as they evaporate.* Flies keep better in a tin case than in an ordinary fly book.

2. Keep your flies flat between layers of silver paper, in a close shutting tin box, and they will keep for years. If the tinsel gets tarnished rub it gently with a piece of soft wood (wedged off to a point), with a little plate powder, to regain its brightness. In both instances exclusion from light and air is essential.

54. *Dyeing Gut.*—To dye gut green, boil a strip of green baize with a small piece of alum, while the liquid is still warm place the gut in it, and allow it to stand for a few hours.

To dye gut blue, heat some ink and in it soak the gut. Do not allow it to stand too long. 20 minutes is enough. It can be stained to any degree of colour, depending on the mixture. A strong decoction of tea, well boiled will stain gut; use in the same way as ink.

55. *Manufacture of Silk Worm gut.*—Messrs. S. Allcock & Co., of Redditch, England, have published an interesting article in their fishing tackle pamphlet on gut, which reads as follows:—

'This is perhaps the most curious and interesting of the many departments in the manufacture of fishing tackle. All anglers make use of silk worm gut, but large numbers are quite ignorant of its origin. In some parts of the kingdom it is called Indian weed, and looked upon as a species of grass, and any attempts to prove its being really the entrails of an insect are derisively resisted. The breaking strain of salmon gut when made into casts is as under:—

Sizes	...	1/5	2/5	3/5	4/5
Breaking strain	...	15	12	10	9 lbs.

Lake and trout casts:—

Padron	Regular	Fina	Refina	1x Drawn	3x Drawn
8	7	5	4 lbs.	3	1 lb.

Gut is made from two small organs situated in the body of the silk worm. These organs contain the silk before it is developed or has been spun by the silk worm; great nicety is entailed in taking the worm at the proper time, otherwise the gut is useless. The worms are thrown into vinegar, and there left for some hours. This process kills the worms and solidifies the organs. These are now taken out of the worm, and pulled out as far as they will go, from end to end. These organs thus extended, being in fact 'the gut', are now left to dry. They are in this stage more or less rough and stringy, but are polished and finished off with some soap and a little soda. According to the size of the organ, so depends the thickness and length of each strand of gut. The strands are then sorted and laid out according to thickness. Gut is, therefore, nothing more than solidified silk; thick gut is doubtless made from larger worms, which are difficult to obtain, and hence the cost is much increased. 'Drawn' gut is very fine, and is made by scraping it down and drawing it through a gauge or standard.

Messrs. Hardly Brothers produce in their Anglers' Guide, some interesting facts of experiments on gut, which I reproduce:—

'Gut or gut casts cannot be tested with a view of giving a guaranteed breaking strain, but in order to give some tangible idea as to the strength of good gut,

* D.D.T. in its many trade forms surpasses all these and has a lasting effect.

elaborate experiments have been carried out in a Science department of one of the Universities. The apparatus used measured simultaneously the strain applied and the elongation produced. These results must be taken as a general guide and not in any form of a guarantee.

The following details from an article in *The Field* are extracts from these tests :—

1. The strength of gut is surprisingly high, calculated from minimum and maximum data actually observed, breaking at 17-23 tons per square inch.

2. The strength of gut is chiefly dependent on the rate of smooth continuous loading. No comparison between the strength of specimens can be made unless the rate of loading is kept constant in all such experiments.

3. The strength increases the higher the rate of loading. Thus a test piece of 2x cast which broke at 3·4 lbs. when the rate was 8·1 lbs. in 100 seconds, broke at 5 lbs. when the rate was 8·1 lbs. in 50 seconds. The bearing of this on the sudden strain involved in striking a fish is obvious.

4. Although of no practical interest to anglers, it was found that dry gut was stronger than damp.

5. The diameter of the casts varied but slightly throughout their length; it increased slightly on damping, and was very constant.

6. The table below gives the smallest breaking stress which was observed in testing various sizes of gut. The average strength would be higher in all cases, but the tests actually made on small pieces cut from the various casts shewed that these would have broken at the loads given in column 3.

Designation of Cast.	Diameter in Inches.	Strength in Lbs.
4x	·006	1·5
2x	·009	2·7
0x	·011	3·5 (another 4·4)
7/5	·013	6·3
6/5	·015	6·6

7. As the stress was applied to the test pieces they elongated, the instrument registering an elongation of 10 per cent. per piece before breaking.'

56. *Knots for tying Gut, Flies, Hooks, and Lines.*—The variety of knots used by fishermen is numerous, and each angler has his own favourite, to which he attributes advantages over all others, so that for purposes of choice, I have listed 24 varieties in diagram, which can quite easily be followed by placing the diagram before one, and with one or two pieces of line the fancied knot can be practiced and mastered. I have mentioned my choice in Chapter V.

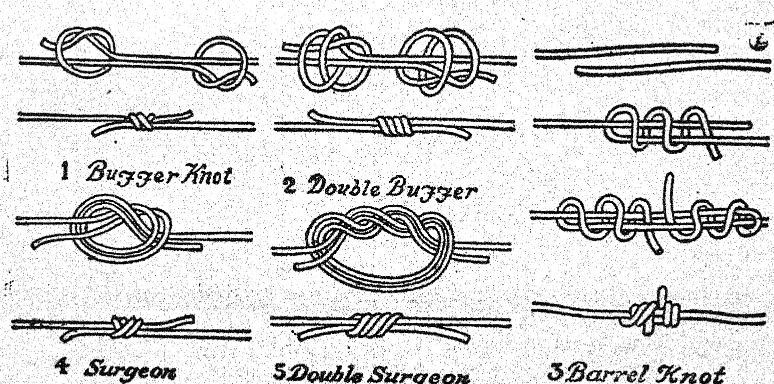

Fig. 75.—To tie two strands together.

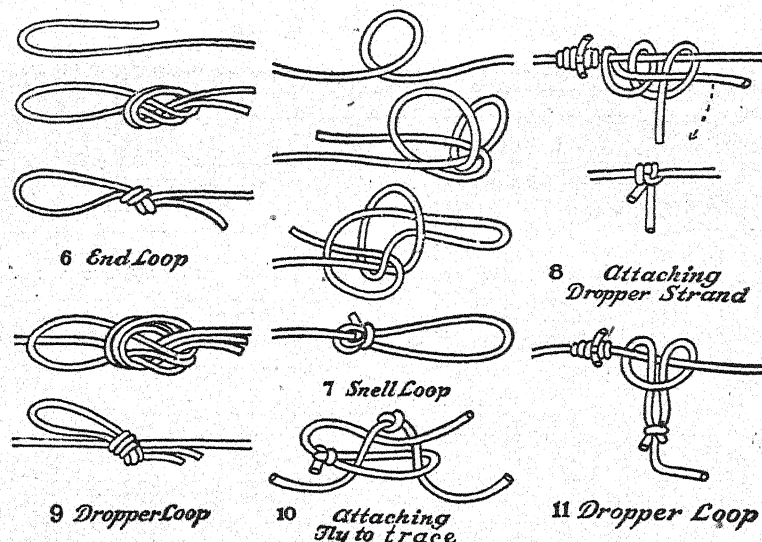

Fig. 76.—*To tie Loops in Gut.*

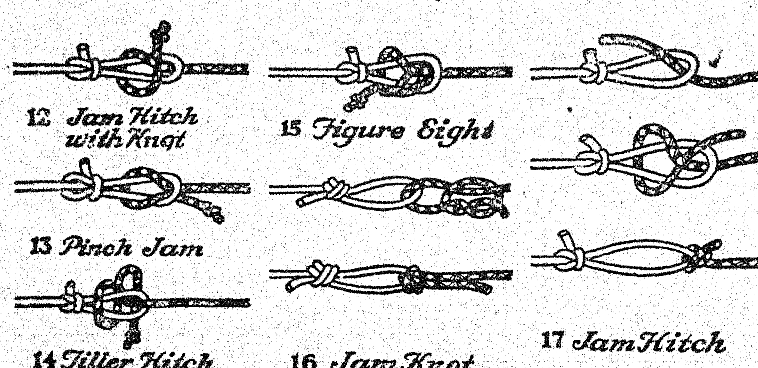

Fig. 77.—*Attaching Line to Trace.*

57. Nylon for casts.

From *The Field* dated May 27, 44 :—

'I think the difficulty of knotting Nylon has been grossly exaggerated. It has been made to appear a sort of voodoo rite which only a witch doctor can perform. This is not my experience at all. For trout and sea trout flies I find an ordinary Turle knot perfectly satisfactory. For salmon flies the knot made by passing the gut through the eye, over the neck of the fly and back through the eye and finishing off with a half hitch seems perfectly safe.

For joining two lengths the double fisherman's knot has served me faithfully. I recently received some Nylon from America, and the firm which made it, one of the Pioneers of Nylon for lines and casts, recommend the single fisherman's knot for joining two lengths. Anyway after the war Nylon will be obtainable in long lengths. I have some 10-yard lengths now, and so the knotting problem will be less acute—if it ever really was.'

58. *Garters*.—I find I can never keep my stockings up for long, while wading about in rapids. I have tried the ordinary woollen

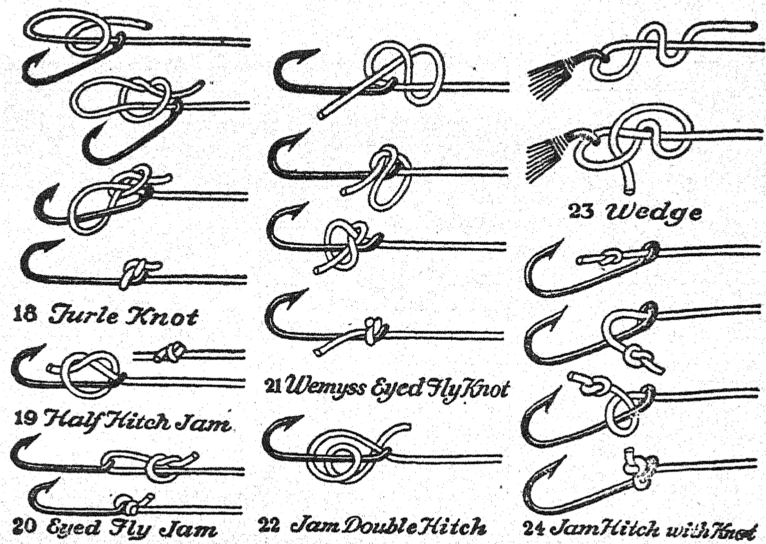

Fig. 78.—*Attaching Gut to Flies or Hooks.*

garters, and elastic, and have now resorted to cutting strips of rubber cross section, through an old inner tube of a tyre, and find they work excellently.

59. *Ankle Puttees.*—Puttees tied over the boots will save many a sore patch on the foot, as however careful one is in tying a boot, shingle, coarse sand and gravel will find its way in through the top.

60. *Sore Toes and Feet.*—With constant wading the feet are sometimes apt to get very sore between the toes, and a form of eczema, rather similar to 'Bengal Rot' attacks the skin of these parts. Grease freely applied will save the feet to a certain extent. Frank Ross & Co., Chemists, Calcutta, make a special ointment for the infection, which I thoroughly recommend. I have found the water so bad in some rivers, that both the boatmen and I were hardly able to walk. The local fishermen told me that if the water is at all discoloured, from storms in April/May, they rub mustard oil over their legs and feet before wading. This curious condition is apparently caused by rotten vegetation or toxic salts being washed into the river. Oxide of zinc powder will disinfect and dry up the sore places between the toes.

61. *Sun Burn.*—Vaseline rubbed over the face, hands and knees, will save peeling and blisters, and much discomfort, if one is not accustomed to the sun. It sounds a messy job, but is really not as uncomfortable as it sounds.

62. *Glare Glasses.*—Sun glasses are very necessary, as one is facing the sun most of the morning and evening (that is if fishing correctly) and the glare off the broken water in a rapid, is intensified, and most trying. Care should be taken to see they are strictly *neutral.* The recently invented 'Polaroid' glasses enable one to see under the surface of the water.

63. *Topee.*—A topee of the Pigsticker type, with a large brim and worn back to front, protects your face. The usual small ventilation holes can be enlarged by insertion of cut revolver cartridge cases, much to the cooling of one's skull.

64. *Jacket.*—A sun proof or khaki drill sleeveless jacket, with lots of pockets that button, is handy for carrying small pliers, scissors, a small tin with fly spoons, swivels, split rings, etc. The buttoned pocket will save losses one can ill afford, as tosses are inevitable while wading.

65. *Tackle Outfit.*—Do not try to buy a complete outfit of tackle, all at once, it hits the 'exchequer' rather hard. Get the few necessities, and add to them each year. A good way of doing this, is to give yourself a birthday or Xmas present, or better still give your wife a nice rod or reel, when her birthday comes along!!

66. *To Skin and Preserve a Mahseer.*—With acknowledgements to Van Ingen and Van Ingen Taxidermists, Mysore:—

'Lay the fish on a board, and make an incision—not down the belly—but along the centre of the side from gill to tail, the heavy bone or scapular arch under the gill covers being cut through at this point, the object being to remove the body from the skin with as little disturbance of the scales as possible.

When skinning, leave plenty of flesh attached to the skin. This can be removed later and do not lift or pull the skin in any way as it is apt to displace the scales.

When the back is reached, place the point of the knife against the base of the fins, and strike the back of the knife smartly with a block of wood, and the obstruction can in this manner be cut through easily.

The body should be disjointed near the head and tail and removed in pieces. The gills, tongue, eyes and all the bones, etc., inside the head be cut clean away. The flesh on the cheeks is covered with very delicate skin. All this flesh should be carefully removed, but from inside the head, so that this skin is not injured.

The head, when finished, should be just a shell. The lips, which are very thick, must have incisions made inside to allow the preservative to get well in. While cleaning the head, particular care should be taken not to bend it back over the skin where it joins the head which is quite narrow and this is where the scales always come away.

After cleaning the skin thoroughly of all flesh and fat, paint the inside with arsenical soap and fill lightly with straw, and small sticks arranged lengthways which will prevent the head being bent over accidentally, and draw the edges together with a few stitches. The skin will then dry in some shape. The fins need not be spread out to dry. A little arsenical soap may be applied to these also. Never use salt or alum. Arsenical soap is the only suitable preservative for fish. Save any of the scales which may happen to work loose.'

67. *Medical.*—Fishermen journey to wild places, far from medical assistance, so should have some knowledge of medicines and first aid. The local jungle people will call for it, and help given will be greatly appreciated. The following list is offered as a guide, which can be added to or altered, according to individual ideas and requirements:—

68. *Medicines.*—

Boric powder: Camphorodyne.

Essence of ginger for stomach colic (servants often need it). Tartaric acid and Chlorate of Potash for scorpion stings.

M. and B. 693 tablets for pneumonia and lung troubles.

M. and B. 720 tablets for septic wounds and pneumonia.

M. and B. 125 tablets for septic wounds.

(a) Calomel 1-grain tabloids.
Cascara. 2-grain tabloids.
Epsom Salts.
Quinine. 5-grain tabloids.
Mepacrine.
Salicyllate of Soda. 5-grain tabloids (for Rheumatism).
Genaspirin or Aspro.
Tinc. Benzoine. Co.
Hydrogen Peroxide.
Germoline.
Iodex.
Winter Green.
Oriental Balm.
Iodine. Rect.
Essential Oil (for Cholera).

D.D.T.—One of the greatest discoveries of the War and responsible for the saving of thousands of lives from Malaria and discomfort from crawling creatures.

5% solution sprayed in the room or tub or to the walls or sides will kill all insects and small creatures that come in contact with the sprayed surface for 10 days. It may well revolutionise poultry farming and rid the rooms and house of ticks that pester the canine species during the hot weather.

Mepercrine.—Yet another discovery of the War against Malaria, it has no taste or ill effects except perhaps a yellowing of the skin, but for which visits to water and jungles would be death-traps in north India.

(b) Appliances.
Bandages.
Eye bath. Eye lotion, Sulphate of Zinc, 2 grs. to ounce of distilled water.
Lint.
Cotton wool.
Permanganate of Potash crystals.
Resinol ointment (for burns and wounds).
Surgical knife, scissors, needles, silk in sterilised bottle.
Two thermometers.
Glass syringe in bamboo case.
Z.O. Plaster.
Prontosil (for sceptic wounds).

69. *Wounds.*—Should be washed by some antiseptic, Peroxide or E.C. Carry a curved surgical needle in case stitching should be necessary. Ordinary gut does excellently for this purpose, in the absence of Suture silk.

70. *Foul Hook.*—I have had the misfortune of having a hook cut out of my calf with a blunt penknife, with two massive beings sitting on top of me, so offer a more kindly way as a suggestion. Take a pair of wire cutting pliers, and snip off the hook below the barb, slightly above where it has buried itself, apply a hot fomentation or poultice, and after this has cooled, push the point through the skin forward, DO NOT TRY TO BRING THE BARB BACK THROUGH THE HOLE IT MADE ON ENTERING, or you will suffer agony, and make a nasty mess. Apply iodine, and the wound will heal quickly. If the seat of the wound permits of an incision being made, make a cut along the hook, and it will come away.

71. *Bleeding.*—To check arterial bleeding apply pressure above

the wound, by bandaging or a tourniquet, but if the tourniquet is kept on for more than 20 mins. at a time, without release, there is danger of gangrene. Make sure you have stopped the bleeding, before bandaging the part, or serious loss of blood may result. Tincture of steel applied to the wound, is the best remedy I know. A copy of Moore's Family Medicines for India should be carried in one's kit.

72. *Blisters*.—Never cut or remove the skin, prick on one side and allow the liquid to flow out. Homocea is a good dressing. To ease the feet on long marches on hot days, boric powder dusted into a silk sock will generally prevent blistering of the feet. Zinc ointment plaster (z.o) over a blister or shoe bite on heel or toe, will enable you to walk in comfort, instead of being dead lame; and the part heals under the plaster which does not come off while bathing or washing. This plaster is invaluable for all small cuts and wounds, also excellent as tape for splicing Castle Connel pattern rods.

73. *Boils*.—Boils can be brought to a head with mixture of soap and sugar, and burst by hot poultices.

74. *Stings. Scorpion Stings*.—The best cure for scorpion sting is the immediate application on the seat of the sting, of a pinch of permanganate of potash mixed with a powder of equal parts of Tartaric Acid and pot. Chlorate. Then apply a few drops of water, leave on for as long as the patient can bear it, then apply water freely. This is a drastic treatment, and may leave the seat of the sting sore and blistered, but it will give relief from the hours of pain otherwise suffered. Keep the permanganate and the other powder in separate bottles, and only mix when applying to a sting.

75. *Septic wounds from Tiger and Panther*.—A very serious thing at any time. Epsom's salts freely applied to the wound is effective (in powder form); but best of all, if you can obtain it, is Prontosil. A German preparation, sold in tubes. Hurry off the patient to the nearest hospital, as blood poisoning is almost always the result. M and B. 125 is now the remedy. This is the same as Prontosil not now procurable.

76. *Fever*.—Prevention is better than cure. Whisky and Quinine are good in moderate doses, for one's self, and quinine for the followers. But I find a good day's fishing and Whisky 'dawai' in the evening, with a flitted net to sleep under, is good enough precaution.

77. *Drowning*.—Artificial respiration, if applied correctly, will often bring a patient round, and should be tried out on any case with any visible signs of life.

Professor Schafer's method which is adopted by the Metropolitan Police, and also by the Royal Life Saving Society, is the best. Professor Schafer's method has two very great advantages. First the patient is laid in a prone position, thus obviating the danger of the tongue falling back and blocking up the Pharynx and at the same time helping in the escape of any water remaining in the lungs; and secondly, far less labour is necessary. The whole procedure is exceedingly easy, and there is no risk of any injury to any of the internal organs, and it has this further advantage,

that no time need be lost after recovering the patient from the water while removing clothing.

The patient should at once be placed face downwards on the ground, with a folded coat or rug if obtainable, under the lower part of the chest, the arms extended in the front, and the face slightly on one side, so as to keep the mouth clear. The operator should place himself on one side of the patient's body in a kneeling position, and facing his head; his hands should be placed flat over the lowest part of the back (on the lowest ribs) one on each side, and the weight of the operator's body should be gradually thrown forward on to the hands, so as to produce firm pressure—which must not be violent—upon the patient's chest. In this way, if there is any water, it is driven out of the patient's lungs.

Immediately afterwards the operator's body is raised slowly, so as to remove the pressure, the hands being kept in the same position. This forward and backward movement (pressure and relaxation of pressure) has to be repeated every four seconds, 15 times a minute, so as to approximate to the natural process of breathing. These movements should be continued, according to Dr. Schafer's instructions, for at least half an hour, or until the natural respirations are resumed.

Shock from lightning, if not serious, should be treated in the same way.

78. *A wife's point of view.*—From THE WOMAN.

'T-t-turn the p-point of the b-boat to the p-p-point of that island!' suddenly stutters my husband. He has just seen a swirl on the water, indicating that a trout is on the move.

Now, what is the perfect wife to do? Around us there are three islands, each of which possesses two points. The boat, not being of the square-sterned variety, has two points. Therefore, I have to choose the correct direction out of twelve possibles—*and in about the fifth of a second.*

Just let me tell you a few of the things expected of me when on the loch with my husband.

I am expected to have a complete and detailed knowledge of the loch, its deep places, its shallow and its skerries. In fact, I must know the bottom of the loch as completely as I know my permanent wave. I am expected to be a first-class oarsman, and must be able instantly to translate a vague wave of the hand into a complicated piece of navigation.

I am expected to fill his pipe exactly to his liking—which is not so easy as it sounds—and I must even light it for him sometimes.

On the few occasions that my husband does hook something, I am apparently expected to fold up the oars and put them out of the way into my handbag.

I am expected to come off the loch feeling bright and cheery after several hours of cold, bleak monotony.

Yes, this fishing is a queer business. At home, my husband is rather faddy about things. The table-cloth must be spotless, the silver must be shining, the glasses must be polished. The tea-table must be 'just it'. Bread must be cut thin and cake thick. Yet, on the loch, he will cheerfully eat sandwiches out of a grubby bag and he will cheerfully drink 'thermos tea'.

At home, an expensive easy chair cannot soothe his limbs. He is restless; he fidgets. First he flings one leg over one arm of the chair; five minutes later he twists around and flings the other leg over the other arm. I often ask him if he would not like to lie on the mat. But, on the loch, he will sit happy for hours on a cold, HARD board. . . .

Why do I do it? Well, m'dear, look at these ducky little fishing hats I wear and, believe me, you can get the most gorgeous sunburn on the loch!

79.—ADDENDUM TO CHAPTER 'SCRAPS FROM MY NOTE BOOK'

For easy reference and convenience, the following blocks, kindly lent by Messrs. Hardy Brothers, Alnswick, England, have been included, with a few details of gut, wire, etc.

GUT SIZES AND DESCRIPTIONS.

Size	*Name of Size*		*Description*
·021	and above	...	Crown
·020	Extra Stout Salmon	...	0/5
·019	Stout Salmon	...	1/5
·018	Fine Stout Salmon	...	2/5
·017	Medium Salmon	...	3/5
·016	Fine Medium Salmon	...	4/5
·015	Fine Salmon	...	5/5
·014	Extra Fine Salmon	...	6/5
·013	Stout Grilse	...	7/5
·012	Grilse	...	8/5
·011	Heavy Lake	...	9/5
·010	Medium Lake	...	0×
·009	Fine Lake	...	1×
·008	Stout Trout	...	2×
·007	Medium Trout	...	3×
·006	Fine Trout	...	4×
·005	...	...	5×

In the specification of all casts listed, the above descriptions are referred to as the thickness of the Casts.

NATURAL GUT IN HANKS OF 50 AND 100 STRANDS.

For those wishing to make up their own traces the following note will help when ordering Gut:—

REFINA.—Fine work.
FINA.—General trout fishing.
REGULAR.—Heavy Trout and course fish.
PADRON, 2nd.—Trout Spinning traces.
PADRON. 1st.—Sea Trout and light grilse.
MARANA. 2nd.—Grilse.
MARANA 1st.—A light Salmon gut.
IMPERIAL.—General Salmon work.
ROYAL.—The heaviest gut.

The best sizes for Mahseer are those listed as 'Fine Stout Salmon' to 'Heavy Lake' sizes 2/5 to 9/5.

Wire for Traces.

'Punjab' Cable-laid Steel Wire.

Made in 8 sizes as below, in coils of 5 yards only.
Colour Black, plated and oxidized to prevent rust.

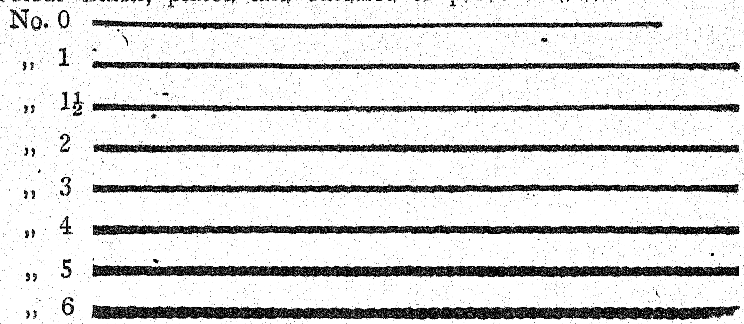

Fig. 79.—Breaking Strain.

No. 0	... 19 lbs.		No. 3	...	70 lbs.
,, 1	... 28 lbs.		,, 4	...	85 lbs.
,, 3	... 35 lbs.		,, 5	...	130 lbs.
,, 4	... 50 lbs.		,, 6	...	200 lbs.

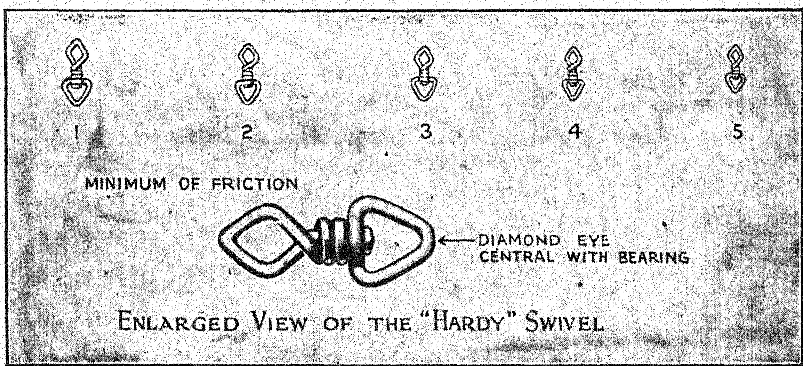

Fig. 80 (*a*)—The 'Hardy' Swivel.
(Is ideal for mounting Fly Spoon).

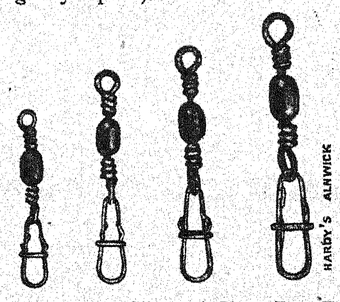

Fig. 80 (*b*)—The Safety Clip and Close Box Tested Swivel.
(For loading and mounting spoons, such as the Myitkyina Spoon).

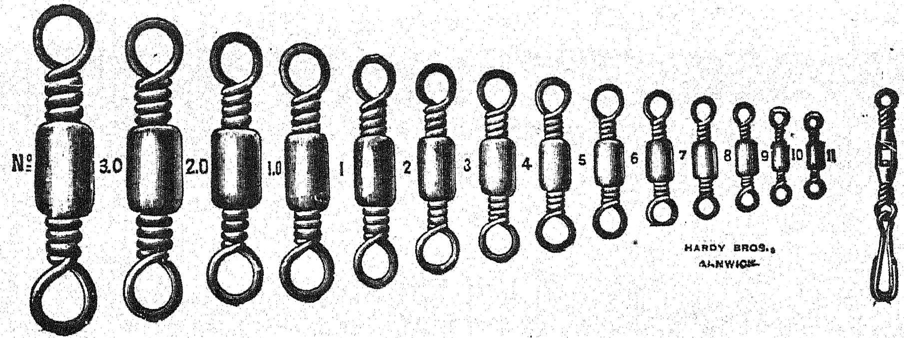

Fig. 81.—Size Scale of Swivels (*Standard*). Link Swivel.

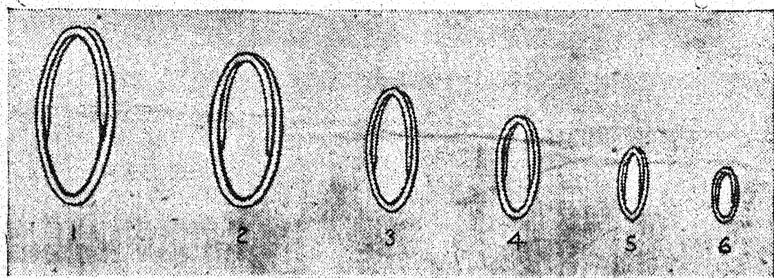

Fig. 82.—Hardy 'Attachment' Links.

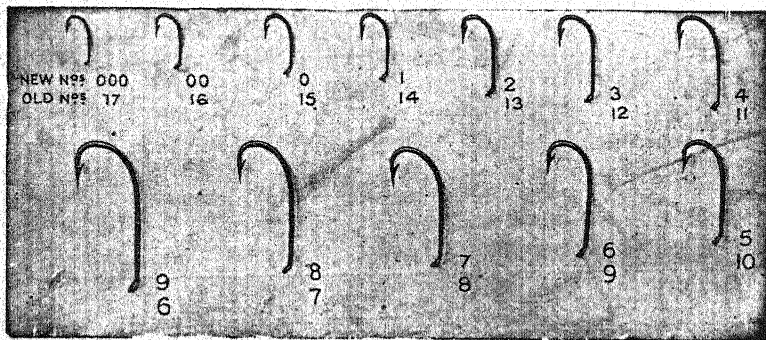

Fig. 83.—(*Single Hooks*) Old and New Scale.

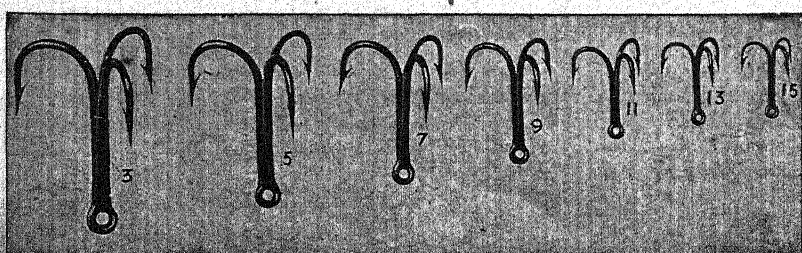

Fig. 84.—(*Treble Hooks*) Ordinary Scale.

B. No. 2. C. No. 2.

No. 12.

No. 10.

No. 7.

No. 6.

No. 4.

No. 2.

No. 1/0.

A.
No. 2/0.

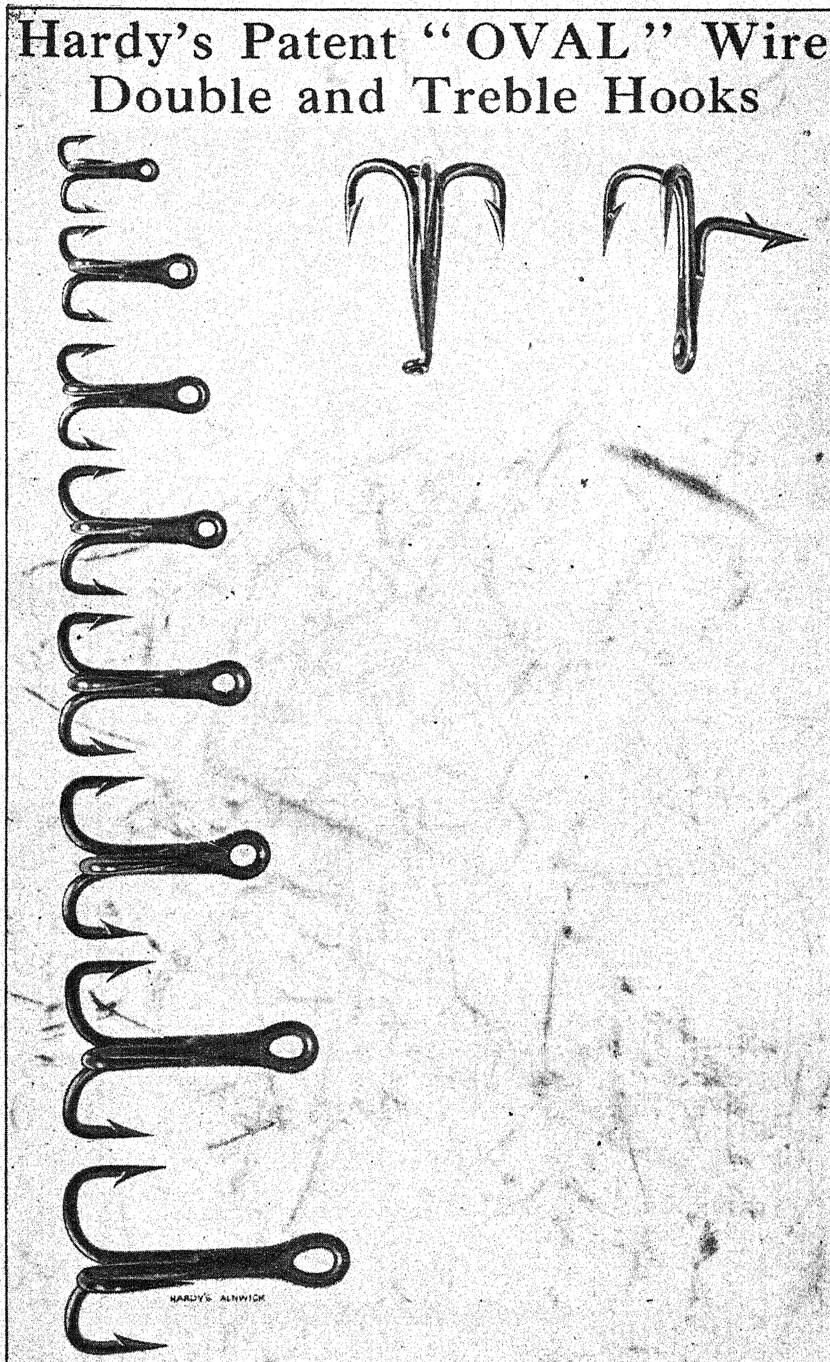

Fig. 85.—Hardy's Patent 'Oval' Wire Treble Hooks.

Extra strong 'Oval' wire. The Best Treble for Mahseer.
A.—Trebles Tapered or eyed.
B.—Double eyed Self-fastening Trebles.
C.—Doubles, spiked, with eyes or tapered.

1. Assam and Dooars.
2. Bengal and Chittagong Hill Tracts.
3. Bihar and Orissa.
4. Bombay.
5. Burma.
6. Central India and Rajputana.
7. Central Provinces.
8. Madras (including Hyderabad State, Mysore State, and Eastern and Western Ghats).
9. Punjab and N.W.F. Province and Baluchistan.
10. United Provinces and Delhi.

This Index of River and Tank Localities does not aim at being exhaustive, nor providing detail beyond acquainting the reader with some of the places where fishing is still to be had.

'The Angler's Handbook' and 'The Angler in Northern India' both provide detailed notes by individuals—unselfishly given 18 or 20 years ago, if the angling community to-day will co-operate on the same line and send notes on rivers and tanks listed therein, with any additional notes, to me direct or to the Society, a full and up-to-date chapter on Localities, or a second part to this book, can be compiled and published for the benefit of all.

The object of this Index is to give a brief list of Localities that the enterprising angler can trace by means of a Gazetteer, or the Road Map of India, or Survey of India Maps, or through local enquiry. The size of the river will generally indicate the size of the fish to be taken.

Detailed maps and sketches are outside the scope of this little book. The chapters on Assam and Burma include some of the best localities and must suffice until more information is forthcoming.

1. ASSAM AND THE DOOARS. See Chapter viii.

2. BENGAL AND CHITTAGONG HILL TRACTS.

Bengal is dealt with under Chapter viii, or rather those portions in North Bengal that are well known in the Districts of Darjeeling, Jalpaiguri, and Mymensingh.

The Chittagong Hill Tracts of which very little is known or, more correctly, advertised, have some good rivers in which mahseer are plentiful but owing to the difficulty in getting to the best places, and the time and 'bundobast' involved, little attention has been given to this secluded part of the Province.

Nothing is known of the Estuary fishing either; but it can be safely asserted that Bahmin and Cock-up will be found in all

the many estuaries all the way down the coast to Akyab and beyond.

District.	Rivers & Tanks.	Remarks.
Chittagong.	Karnaphuli. R. Sajjuk. R. Mayani. R.	I have been given most attractive accounts of the Races and Pools of the upper waters above *Rangamati* and *Barkal* in the tributaries Sajjuk and Maiyani by a non-angler.
	Sanju. R.	This river, further to the south, also traverses wild country and holds promise of good sport.

3. BIHAR AND ORISSA PROVINCES.

Bihar, north of the Ganges has numerous rivers draining through to the South-East. Above Patna the Gogra and Gandak join in from the left bank, and the Sone from the right bank, swelling the Ganges to three times its former size; further East the Kosi, another huge river, runs over the country in numerous channels and joins the Ganges in the Purnea District.

There is an abundance of fish life of all kinds though little to offer the Angler, except in the smaller streams where one can have good sport with Butchwa and sometimes Silund. But for the Tank Angler this provides the best fishing in India. There are innumerable lakes formed in the Districts of Champaran and Mozufferpore which hold monster Rohu and Catla, besides all the predacious fish. There are numerous tanks dotted all over the country, almost one or two in each village, stocked with fish of all kinds.

In the Darbhanga District there are huge tanks too large to net to extinction, besides many others protected by Zemindars who will permit fishing if approached. In Darbhanga itself there are a number of large tanks, almost lakes, that hold enormous fish, in which one may fish after obtaining permission from the Raj.

To list these tanks would fill a tome. Local enquiry will soon satisfy the Angler; and the nature of the tank with its old banks and trees will indicate the age of the tank and size of fish to be expected.

Districts.	Rivers & Tanks.	Remarks.
Champaran.	Gandak R.	*Tirbani.* North of Bagaha, is in the N. corner of the District and is the headworks of the Canal. I have been told of some rapids below this point, but no one appears to have caught any Mahseer here though the 'Malars' bring in 30 and 40 lb. fish for sale into the local markets.
	Tanks.	*Bettiah. Raj.* Have some tanks well stocked with Rohu being protected from netting; permission to fish can be obtained.
	Lakes.	*Motihari.* Has two large lakes (the old bed of the Buri Gandak) full of fish. These lakes continue

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Champaran—(*contd.*)	Lakes—(*contd.*)	all the way down to Mozufferpore on both sides of the Buri Gandak, which flows in a south easterly direction, joining the Ganges in Monghyr District.
	Buri. Gandak R.	Fed from Nepal it is confined between high banks throughout its course in Bihar. It runs clear and is full of all kinds of fish, and gives good sport with Butchwa and Silund, but is little fished.
Mozufferpore.		*Mozufferpore.* It enters the District near Mehsi and leaves it near Pusa. The same remarks hold as those mentioned for Champaran. It passes through Mozufferpore town to the North.
	Lakes.	There are a number of lakes similar to those in Champaran in this District. Also plenty of good tanks.
	Bagmati R.	Flows into the District from Nepal near Dhang St. on O. & T. Ry. in the North of the District Mahseer have been caught at the bridge, but for the best fishing one must go into. Nepal, where it is excellent, but permission must be obtained: No easy matter, as it is the sacred river of the Country. In its lower reaches it gives good sport with Butchwa and the other predacious fish. It also flows into the Ganges in Monghyr District.
Darbhanga.	Buri. Gandak R.	Enters the District near Pusa and leaves it at Rusera passing through Samastipore on its way, I know of good Silund being caught at Dowlatpore 3 miles from Rusera. It is little fished or would give good results. Tank angling is so good that the rivers receive little attention.
	Bagmati R.	The Darbhanga line crosses the river at Hayaghat Stn. It is very similar in formation to the river Gandak with the same fish.
	Tanks.	There are literally hundreds to choose from and local enquiry will satisfy any one interested. I took out of the Mohanpore tank near Ryam three Rohu one evening of 33,32,30½ lbs. and with another rod in a tank near Benipore 17 fish in three hours best 17 lbs.
Chupra.	Tanks.	In Chupra at the old Dharamsala is a very old Tank, where the fish are fed, and one can see 20-40 lbs. Ruhu come up and take parched rice on the surface; fishing is not permitted. There are other tanks but it is poor in comparison to the other Districts mentioned. The rivers are too large to be worth while.

District.	Rivers & Tanks.	Remarks.
Bhagalpore	Kosi R.	North Bhagalpore is drained by the many channels of this mighty river that knows no bounds, and shifts its course as much as 30 miles in a single Monsoon Season. From a fishing point of view it holds little attraction in the District, except for netting of the parish fish, of which there is a good supply. The Ganges is at Bhagalpore but it is a vast wilderness of water, and uninteresting from an Angler's point of view. I have heard of good fishing in the Kosi in the North of the District, but for Mahseer one must get into Nepal, for which special permission is required. I have had great accounts of the water below the last gorge and where the river fans out into a sort of delta and breaks up into several large channels and some excellent fishing is available.
Purnea	Kosi R.	The main channel of the Kosi passes under the Ry. at *Kursala* forming the boundary of the District with Bhagalpore, but is flat and sandy, and uninteresting.
	Panar & Kankai R.	Further east the Panar and Kankai rivers drain from Nepal into the Ganges, but nothing is known of the fishing. A large portion of the fish from this District is sent to the Calcutta market.
Purnea.	Panar & Kankai R.	There are a number of very old and large tanks belonging to the Darbhanga Raj, with excellent tank fishing. There are besides a number of lakes, formed by the old river bed of these wandering streams, in which good sport can be had with murrel.

South Bihar and Orissa has hilly country with a number of rivers feeding the *Sone* in the North-West, chief of which is the *Koel,* in the Palamau District which holds Mahseer, and has a number of good runs and pools near *Daltongung*.

West of *Daltongung* lie the Eastern States of the C. P., *Surguja* etc., with wild hilly country and a network of rivers, with great possibilities. Little is known of this tract of country from the Angler's point of view. The *Rer,* and another large stream just above *Bardi* join the Sone, and should hold Mahseer.

The *Bashda* rises near *Sonhat* and flows south to join the *Mahanadi,* but there must be many other good streams of which nothing is known.

Further South in Orissa are the Feudatory States with the *Ong, Suktel,* and *Tel,* all of which flow into the *Mahandai* near *Manda* in Sonpur State. The Tel is the largest of these and has a number of tributaries in *Kalahandi* State.

The *South Koel* in *Singbum,* and *Santh* further West join in *Gungpur Stream* and run on as the *Bhramini* River entering the Sea at *Hansua.*

Ganjam District is one of the districts ceded to Orissa by Madras, in the extreme South. It also has a number of rivers but no notes are available.

4. BOMBAY PRESIDENCY.

These brief Notes are only part of the wealth of information that must be available to Anglers. I have avoided mention of Sea Fishing as this is dealt with under Chapter II.

For those interested I can do no better than recommend that excellent publication by the B.N.H. Society 'Game Fishes of Bombay'. It has coloured illustrations of a number of fish and contains a host of information. It is sold at the very modest price of Rs. 2/-.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Ahmednagar.	Godavari R. Prewara and Mula R.	Forms the N. and N. E. boundary with Aurangabad. These two rivers join at, or just above *Nevash* and flow on for 12 miles or so to join the Godavary; running through some wild country. *Paithan* on the borders of the Aurangabad District has a junction but no details are available. The Gazetteer would help.
Ahmedabad.	Subarmati R.	A huge pool about a mile from Cantonments below *Achar,* V, on the opposite bank, with a slow run into the top of the pool, and under a cliff on the far bank. It is good in the late evenings and early mornings. I had good sport here in 1919 ! l and caught several fish of 4 and 6 lbs. Mahseer *Kanker-Beds.* 6 miles up-stream are some rapids we knew as the Kankerbeds, it is past the pig-sticking country, and under a cliff. I had grand sport with Mahseer of 8 lbs. and Rohu of 4 lbs. which I caught with green weeds used as a fly. It is a long, tiresome trudge, but worth it. *Rayasan.* 14 miles up-stream, and connected by bad road, has some good water but it varies from year to year. The pool at the place may go off and the water at *Koha.* V. 3 miles down improve, or at *Radasan* 1½ miles above. *Mehmedabad.* Half a mile by rail south of Ahmedabad, some good water a mile or so above the bridge. There are besides some good places up the Metre gauge line where I had good sport with fly spoon about 4 stations out. Notes lost.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Belgaum.	Gatprabha R.	*Sulgatti.* 17 miles from Belgaum holds fish up to 20 lbs. *Punderi.* 32 miles from Belgaum, with a R. H. a few hundred yards from the river, which is quite good water.
	Tamrapani	Tambulwadi R. H. and bridge over the Tamrapani stream, a tributary of the Gatprabha also holds Mahseer.
	Dhupdal L.	*Dhupdal.* Station has a large lake formed by an artificial bund which holds fish.
	Gokak Falls.	*Gokak Falls* three miles down stream has a deep pool full of fish but difficult to approach. These rivers run dirty for a considerable time after rain, which takes away from their attraction.
Bijapur.	Kistna R.	*Kistna* is joined by a river from Belgaum, I think it is the Gatprabha, which fishes well in the Belgaum District. No first hand notes available.
Bombay.	Ulhas R.	*Uhlas R.* (Kalyan Creek) the tidal part of this from Bassein up to the Railway bridge some miles above Kalyan is good for Bektie or Cock-up wherever there are rocks. Fish much over 50 lbs. have been caught on live bait. Spoon is entirely useless. Plugs are better. Fish are not plentiful. Best time August/October in turbid water. Bahmin do not ascend the creek much above Ghod Bunder.
	Kalu R.	*Kalu R.* the non-tidal parts of this, an affluent of the Uhlas, and of the Uhlas itself, hold carp and Mahseer up to and above 15 lbs. in restricted numbers. A well known spot is near *Neral.* Murrel and Wallago also frequent those waters.
	The Ghat Lakes.	Lakes *Andra* (L. Gibbs), *Walwan, Sheravta,* and *Mooljee* (the latter at the head of the Moola valley) all hold fairly good mahseer and carp (*Barbus dobsoni, B. jerdoni*) the largest in *Muljee* Lake. Permission to be obtained from Messrs. Tata & Co. Bombay. A collapsible punt is very desirable for successful fishing in these lakes. Trolling, spinning, and bait-casting are successful.
	Lake Tansa.	*Tansa* 55 miles north of Bombay provides part of the water supply.
	L. Bhiwandi.	*Bhiwandi* 29 miles from Bombay approached by Agra road.
	L. Beale.	*Beale* between Gote and Asvali Stations is 17 miles long. *Niphad* Stn. is near the lower lake formed from Lake Beale and connected by the Darna R.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bombay—(*contd.*)	L. Arthur Hill.	*Igatpuri.* 26 miles S. and formed by the Bhandaradara Dam. It feeds the Pravhra. R. 14 miles of good water with fish up to 20 lbs.
	L. Andra or Gibbs.	*Andra.* A good many miles to East of Bhor ghat is also a good place.
	L. Sheravata.	*Lonavla.* In the neighbourhood is this Lake also *L. Walwan* which is reported to hold big fish. Most of the fishing in the lakes is mixed and anglers will tackle chilwa if nothing else is available. It is treated rather as a side show.
N. Kanara.	Kalinadi R.	*Kalinadi R.* This and other rivers *Gangavali, Tadri, Sharavati* (on which Gersoppa Falls, 830 ft.) all hold mahseer, together with their tributaries. All these rivers drain the District westwards into the Arabian Sea. No detailed notes are available.
Khandesh.	Girna, Tapti, Panjkra, and Bari Rs. also the Narbada for wh: see C. P. Section.	No notes in the fishing books as to these waters but there must be many places where good mahseer fishing is to be had by the adventurous angler.
Poona.	Lake Fife.	Near *Rhadakwasla.* Fish are taken trolling with spoon or dead bait. 'Mahseer Fishing in the Deccan Lakes' by Major Trevenen, *Bom. N. H. S. Journal,* vol. xxxi, p. 120 is a good reference.
	Bhima R.	*The Upper Waters.* About 10 miles north of the Nasik road the river is fishable for mahseer up to 10 lbs. or so in various runs, during and immediately after the rains for a short time only. There is a rocky chasm quite often holding huge goonch and fair-murrel, besides mahseer. *Bhima R.* This holds good for the fish in the fine pool below the confluence above *Pargao* village, I have seen mahseer of 30 lbs. netted there. The big pool near *Nandgaon* (off *Patas*) is too broad for fishing from shore. It becomes shallow in the dry weather and is good in and shortly after the rainy season only, when large fish may frequent it. The rocky runs below the pool, and the water into which they run, are also good in the same season. A dug-out canoe is usually procurable at the big pool at one or other of the villages. Patas is 40 miles from Poona on the Sholapore road.
	Mula R.	*The upper waters of the Mula,* i.e., from above Kirkee to Kooljee Lake, present several fair runs shortly after the rains and good

Districts.	Rivers & Tanks.	Remarks.
Poona—(*contd.*)	Mula R.—(*contd.*)	pools throughout the year with carp and mahseer rarely over 10 lbs. Also fair murrel and wallago *Mutha Mula R.* The pool at Kirkee is still fairly tenanted. There are now three dams below it including the one near the Fitzgerald bridge, so that fish can no longer reach their old spawning grounds in the upper valley. The spot near 'Snake Island', which still haunts the literature, is completely useless since many years for spinning and trolling and holds no sizable mahseer nowadays. The stretch below the bridge and up to the Cavalry falls is still frequented by a few fish up to 25 lbs. during and shortly after the rains, but sizable fish are few and far between. They respond to spoon, dead bait, and plug, but prefer paste, crab, or such country baits as chapati or a triangular slice of coconut spun like a spoon, with a single hook tied to it, or better still the single hook concealed between two thin slices. This is a very killing bait in slightly coloured water. It spins very well in fairly fast water and is very attractive. Further down there are good runs at *Loni* and *Theur* yielding fish of the same size, but not many. I believe that the three dams in Poona have made the river unpopular with mahseer as these three dams create a dead end, or 'culdesac'. The pool just above the confluence with the Bhima still holds a few good mahseer, but they disdain all artificial lures. Bottom fishing is the only way with them.
	Ghod R.	*Ghod R.* The part north of the Nasik road runs through pretty wild country and holds some great fish in the vicinity of *Ambegaon* Fishable after the rains. This part is not easy of access and camping is a necessity. A deep, rocky chasm on a small tributary some 16 miles from *Sirur* holds large fish (mahseer and silund) very difficult to land as the rocks are high above the water. This is certainly the place mentioned in Thomas's 'The Rod in India' 2nd edition 1881, page 337. The word 'Dav' in the same para probably refers to the village *Dehu* on the Indrayani River in the Poona area. I have seen mahseer up to 50 lbs. netted in the *Ghod R.* some six miles from Sirur where their

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Poona—(*contd.*)	Mula R.—(*contd.*)	retreat down river had been barred by a palisade of stakes. This was after the rains when large fish retire from their spawning grounds in the Ghats and return to the deeper waters of the Bhima lower reaches. Very large goonch are also caught there. This, by the way, is the type locality for Sykes's *Barbus mussulah* the very hump-backed and heavy, golden-bronze coloured mahseer of the Deccan, which I believe to be identical with the record fish of the Cauvery river. It is distinct from the ordinary more Slender Deccan Mahseer which Dr. Hora has classified as *Barbus* (*Tor*) *khudree,* Sykes. All the above as to Poona rivers also Ulhas R. and Ghat Lakes is, contributed by Dr. M. Suter, D. Sc., and gratefully acknowledged.
Poona.	Indrayani R.	*Shelavadi* Station on Lonavla-Poona line is 4 miles from Dehu where is a temple and pool full of sacred fish up to 40 lbs. and over.
	L. Whiting, Nira R.	*Bhartgarh.* The Lake is formed by the Lloyd Dam and Nira R. which also carries off the overflow. Good fishing is reported in both the lake and river. *Ing.* 3 miles below the lake has some good runs.
Satara.	Warna, Keina, Yerla Rs.	The Warna is in the South. The Koina runs through the centre, and the Yerla in the East of the District. All are tributaries of the Kistna and must hold fish. No notes available.
Surat.	Parr R.	*Bulsar.* Take a bus on to the river. Good sport is reported both above and below the Ghat.
	Kolak R.	*Udvad Stn.* The river is two miles south of the Station. Holds mahseer and other fish.
	Dhamanganga R.	*Dhaman Rd. Station.* The river is $1\frac{1}{2}$ miles South of the Station. A few miles up-stream is reported to be well stocked with fish, both fresh water and estuary. Two miles below the Ry. bridge and near the Salt Dept. bungalow is reported to have good estuary fishing.
	Sanjan R.	*Sanjan R.* 1 mile South of the Sen Station is well stocked with estuary fish.

A reference to the Road Map of India will show the Angler that there are great possibilities for estuary fishing all along the Surat coast where the Tapti and Narbada rivers enter the sea.

5. BURMA, see Chapter vii.

6. CENTRAL INDIA AND RAJPUTANA STATES.

Little is known of the fishing in this vast area, except perhaps by the privileged few, keen on fishing, who have served in these States.

There are said to be large mahseer in some of the Udaipur Lakes. In earlier days, as we know from articles in the Oriental Sporting Magazine of the middle 19th century, the Chambal river and its many tributaries afforded large catches of *Barilius Bola*. It is probable that the same species still afford opportunity to those who can visit those regions.

Skene Dhu makes brief mention of indifferent fishing near Mhow. Notes regarding the Narbada River in the Central Provinces and Bombay localities lists should be referred to.

Any Notes on the Chambal and other rivers would be of interest to Anglers and science alike.

STATE.	RIVERS & TANKS.	REMARKS.
GWALIOR STATE.	Chambal R.	The largest river in Central India. It rises in Indore near Mhow taking in a large number of tributaries of considerable size
Kotah, Bundi, Nerwar and Datia		which rise in Kotah, Bundi, Nerwar, Datia, etc. It runs in an Easterly course skirting Gwalior State on the North to join the Jumna near Etawah. (U.P.).
Indore State.	Nerbudda R.	*Mhow.* is well situated for the streams in the South of the State that drain the Satpura R. into the Nerbudda.
Rajputana.	W. Banas R.	*Banas R.* rises in Sirohi in the South the drains the western portion of the Aravalli Range, and runs into the Runn of Kutch.
	Sabarmati R.	*Sabarmati R.* also rises in this range (for notes on this R. See under Ahmedabad).
	Mahi R.	*Baswara & Durgapore.* The Mahi rises in the hills in these districts, it is wild hilly country, but nothing is known of the fishing or fish.
	Banas R.	Not to be confused with the Western Banas which runs west. *The Banas* also rises in the Aravalli R. but follows a North-Easterly course, taking in the Kheri, Kotari, from the West and the Berach from Tonk State near Udaipur. The Banas joins the Chambal about 20 miles East of *Sawai-Madhopur Jn.* on the B. B. & C. I. Ry.

7. CENTRAL PROVINCES.

This Province may well be divided into four sections. The North is drained by the tributaries of the Jumna; the West and Centre by the Narbada and Tapti flowing into the Arabian Sea. The South and South West and greater part of the Central

portion is drained by the largest of its rivers flowing into the Godavary through the Warda, Penganga, and Wainganga, which form the Pranhita. The East has the Mahanadi and Seonath, with their many tributaries, leaving the Province at Chandranpur.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Amraoti.	Ganga, Katbi, Sipna Rs.	*Ellichpur.* For full details see under Khandwa.
	Wainganga River.	Dongaghat is a good place with fish over 20 lbs. The large fish are taken on atta, the smaller ones take spoon. For further details refer to District Gazetteer for detail of approach. Padregunj, a little south of Nainpur on B. N. Ry. has some excellent water, I have heard of big fish being taken and others lost. The Laknagunj Gorge, up-stream a couple of miles, is a celebrated place, fish take both spoon and atta.
Bhandara.	Wainganga R.	*Wainganga R.* there is very good fishing in this District but I regret I have lost the Note sent to me by a Forest Officer who caught some good fish both in this river and the one which drains the District further East! (name not available). It joins the Wainganga just north of Ambgaon (in Chanda) in the extreme South of the District. Fish well over 20 lbs. were caught by this rod. 36 miles from Nagpur on the Raipur road are some good rapids down stream about 9 miles. Bait with atta, then fish with spoon or paste balls when fish have collected.
Bilaspur.	Hasdeo R.	*Hasdeo R.* a tributary of the Mahanadi and joining it at Seori Narayan a few miles below. Banjo in Uprora Zemindari has some good water; Best mentions in his Shikar notes some good water 15 miles north of the Railway.
Chandrapur.	Mahanadi R.	*Mahanadi R.* Padampur, and water between Seori Narayan and Chandrapur is good, with fish over 20 lbs. For details refer to Dist. Gazetteer.
	Maniari R.	*Maniari R.* a tributary of the Seonath R. and joining it at Satti Ghat about six miles S. S. W. of Bilha Ry. Station or 15 miles S. W. of Bilaspur. ***Lormi*** on this river is mentioned by Best as a good spot, and fishes all the year round. Fish of 5 lbs. have been taken. The route to Lormi is *via* Mungeli 30 miles, then by track for 16 miles. There is a Rest House, P. O. and Police Station at Lormi on the banks of the river. 30 miles from Bilaspur

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chandrapur.	*Maniari* R.—(*contd.*)	where the Raipur road crosses the river, is said to be good.
	Seonath R.	*Seonath R.* Nandghat. A good run 600 yards above the bridge, and another run about the same distance below.
Buldhana.	Tank.	The drinking water tank has good Murrel and a few Butchwa. Good fun can also be had with chilwa with a fly. It is a mile out.
	Khamgeon Tank.	*Khamgeon Tank* also has a large tank and it is here I have caught Murrel on fly in the evening and when the shoals are rising. The only place I have found Murrel rise in this way.
Chanda.	Indravatti R.	*Indravatti R.* joins the Godavary in the S. E. corner of the district. Allapillai 75 miles then on to Repanpalli 21 miles along the Seroncha road. Turn off the main road close to R. H. and go East by a cart track to Damarincha (15 miles) to Palli another 15 miles, total 51 miles, near Damarincha is the Bandia R. a sandy bed and heavy going. Except for this river the cart track, offers no difficulty. Make for Bhamragarh 4 miles upstream where there are several runs and reports of monster but elusive fish. At Bomragarh is a Bungalow. Semanapalli about 6 miles above junction of Indravatti and Godavari has a pool full of big fish. A Forest R. H. here. One hears wonderful accounts of monster fish of 80 lbs. being seen and tackle broken. It has always remained a dream of mine. An old shikari reading these notes writes that when he was at Warda Junction on 22nd March 1898, on way to Chanda and the Indravatti, he met an Officer from Poona who had had all his tackle torn to bits by huge mahseer of the Indravatti. He (my present informant) was at Damarincha by the 26th April 1898 and caught a small mahseer of the thick lipped type. Then he got bad remittent fever and had to return to Cantonments. It was not until 1929 that he was again able to get to the Indravatti and that was at end of April. He fished from Bomragarh for several days, trying all methods, without success. He had the impression that the river had been largely denuded of fish owing to extensive killing of all fish and fry in the upper waters of the river and

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chanda—(*contd.*)	Indravatti R.—(*contd.*)	its tributaries by the aboriginal inhabitants of Bastar State. During his stay the locals were unable to get *any* fish by means of cruives or other means. In 1924 a friend had lost a very big fish in the long, deep pool below the Bungalow. It was hooked on atta. Probably the season for the Indravatti River would be February and March, and again after the Monsoon. Fever would have to be guarded against.
	Pranhita R.	*Pranhita R.* runs into the Godavari R. in the extreme South of the district and I have heard wonderful accounts of monster fish of 80 lbs. being seen, and tackle being broken. These waters have always remained a dream of mine and though I have planned to visit South Chanda twice I have never managed to do so.
	Wainganga R.	*Wainganga R.* four marches from Chanda on the Sironcha road the fishing water is both above and below the cause way for about a mile. Fish of about 15 lbs. have been taken. In this District, in the South East corner, is a host of places; but they are very difficult to get at. Were it not for this the fishing would have lured the keen angler long ago and many a good bag would have been recorded.
Chhindwara.	Penchi R.	*Penchi R.* a tributary of the Wainganga rising in the hills South of Pachmarhi.
	Jilmilli.	Jilmilli 14 miles from Chindwara on the Seoni Road is reported as having good water. Kundlai is a small village in the corner where the three districts of Chhindwara, Seoni and Nagpur meet, roughly 25 miles S. W. of Seoni. Khawasa about 30 miles from Seoni on Nagpur Road 12 miles West the River is crossed, and has good water. Bait with gram or atta for small fish of 5 lbs. or so. Alikutta is 6 miles upstream from Kundlai is mentioned as fishing well in the early part of the Season.
Damoh.	Bearma R.	*Bearma R.* Nohta, 52 miles on Jubbalpore road is a R. H. on the banks of the river. Best water a short mile up-stream. Best in the early part of the season water too low in the hot months.
	Ken R.	*Ken R.* the line to Katni crosses one of the main tributaries of the

Districts.	Rivers & Tanks.	Remarks.
Chandra—(*contd.*)	Indravati R.—(*contd.*)	Ken about 30 miles from Damoh. Good at Ghat Piperia in the early part of the season. A good block for tiger with a nice F. R. H. overlooking the river.
	Sonar R.	*Sonar R.* Narsinghgarh, 10 miles North of Damoh. A large pool below a high bank on the right bank of the river from which big fish of 30 lbs. can be seen on occasions. The river is about half a mile N. W. from the R. H. The best time is early in the Season while the runs are still strong. Bait, gram and atta.
		Hatta, 22 miles by road to the North of Damoh is another place mentioned.
Hoshangabad.	Nerbudda R.	Two runs opposite the Judge's Bungalow. One well out in the River the other near the bank. The further one is the better of the two.
		Bandraban, 6 miles up-stream from the town, the Tawah joins the Nerbudda. Above this is good water. Bait atta or gram. Best season April/May, fish run to 10 lbs.
		Karraghat, the Ry. crosses the river two miles west of the town, this is good water, if runs are first baited with atta.
		Nandpa, 20 miles S. W. of Hoshangabad is another good spot after baiting with atta.
		Gadarvada Stn. 72 miles East of Itarsi the line crosses the Shakkar R. a tributary of the Nerbudda R. Two or three good pools within 4 miles of the Station and one very good one half a mile above the bridge.
Pachmarhi.	Denwa R.	*Denwa R.* at Pachmarhi small fish have been taken in Oct. on fly spoon at Panzy-pool and Watersmeet. Above *Matkuli* is also mentioned as good water.
		Fullers Khud small fish can be taken on atta.
Jubbulpore.	Nerbudda R.	*Nerbudda R.* Bargi, 14 miles out on Seoni Road, the river is about two miles from the road. The Tamer joins in near here. Three runs worth fishing with gram.
		Bahoripar is 9 miles down the Seoni road where a track takes off, motorable in dry weather, about 1 mile distance. Cross the Ry. and the river is about 1 mile further on. Bait with gram before fishing.
		Guwarighat, 5 miles down Seoni Road. Runs are only a few hundred yards away. There is also some

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Jubbulpore—(*contd.*)	Nerbudda R.—(*contd.*)	good water near the Ry. Bridge 2 miles up the river. Tilwaraghat, 8 miles from the town or 3 miles below Guwarighat, has a good run and I have heard of good fish being taken on gram and atta. Lamheti is two miles further down, and has three good runs. *Bheraghat,* Notha 52 13 miles from Jubbulpore, has a R. H. run below Bungalow holds fish.
	Bearma R.	*Bearma R.* Notha 52 miles down the Damoh Road. Fishes best in Oct. after the rains, when good sport can be had with not only mahseer but Silund and Butchwa.
	Belkhund R.	*Belkhund R.* Dhanwani & Chugra. 33 miles from Jubbulpore. Follow Sehora-Khamtara Road to $5\frac{3}{4}$ mile stone, and turn South along track to Chugra. Dhanwari is about a mile up-stream. Some nice pools and small runs.
	Gaur R.	*Gaur R.* Guraiyaghat, 5 miles out on Mandla Road, good fun can be had below the causeway in a fine spell during the rains or in October when the water clears. Kosamghat, 4 miles up-stream, has one or two nice pools, much fancied by Indian fishermen. Pararia, $1\frac{1}{2}$ miles down-stream has a small bund across the river which breaks up the water and is good after the rains for small fish.
	Goorda R.	*Goorda R.* in the Seoni Road, looks a likely river, for small fish.
	Hiran R.	*Hiran R.* Ganiari, Leave Jub-Damoh Road at $17\frac{1}{2}$ milestone and take cart track for a couple of miles. Some nice runs and pools which hold good fish. Kakarhatta, $20\frac{1}{2}$ miles down Damoh Road. Some four good runs here and ask for Mawah and Bandar Ghats, the two best places.
	Mahanadi R.	A tributary of the Son and Ganges, which rises in Mandla, and joins the Katni R. North East of Katni town. Crossed by the Shahpura Road at mile 37, where the water looks good. Wasari, 16 miles East of Katni on the Barhi Road is the only place I know where it has been fished with success, but it is a fast flowing and rocky stream and must be good in a number of places. Fish will take spoon in this river besides atta and gram.
	Temar R.	*Temar R.* joins the Nerbudda near Bargi, and has fished well at times. Basanpani, Temar and

Districts.	Rivers & Tanks.	Remarks.
Jubbulpore—(*contd.*)	Temar R.—(*contd.*)	Bargi all on the Seoni Road are favoured spots, but I have no details of sport.
Khandwa.	Ganga R.	*Ganga R.* is crossed by the Burhampur-Edichpur Road 5 miles West of Dharni village and 2 miles from its junction with the Tapti. Dharni has a R. H. and P. O. and is 58 miles from Ellichpur. There is good fishing here and lots of good water for gram and atta. Tapti fish do not fancy spoon.
	Katbi R.	*Katbi R.* is a tributary of the Ganga. Balkhund has a R. H. overlooking a big pool full of fish. It is 18 miles from Harisal on the Akot Road. When the river is high there is a fall into the pool and must be good. No details available.
	Sipna R.	*Sipna R.* also feeds the Tapti joining it at Kegda a few miles N. E. of Dharni. Melghat, Best claims to have caught Mahseer with spoon, both large and small. Other places mentioned are Semadoh, Rakhidih, and Harisal.
Mandla.	Nerbudda R.	*Nerbudda R.* Dindori, 50 miles N. E. of Mandla is reported to have fished well. Sahasradhara is only three miles down-stream from Mandla where there is a nice fall at the head of a deep pool. Large fish have been hooked here. Imdhi, 6 miles from Mandla on the Jubbulpore Road has a small fall at the head of a nice run which widens into a deep pool and holds big fish.
	Thanwar R.	*Thanwar R.* is a tributary of the Wainganga and is best approached from Padregung. I had a note years ago by a Ry. Official who caught some good fish of 20 lbs. and over and lost a lot of tackle in others. Fish take a spoon in the Wainganga system.
Nagpur.	Penchi R.	See notes under Chhindwara.
	Wainganga R.	The river forms the border of the district in the E. with Bandara, there are some good fishing spots.
Narsingpur.	Nerbudda R.	Barhman to the N. and where the Saugor Road crosses, there is some very nice water, and good sport has been had fishing with atta and gram.
Nimar		The Dharigha Falls: a grand place for fishing. Season after the S. W. Monsoon, as soon as the river begins to clear. Also March but then heat is very great.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Nimar—(*contd.*)	Nerbudda R.—(*contd.*)	There is a basaltic barrier across the whole river, about 500 yds. wide at this point. The water falls in a series of cascades through passages worn in the rock. Fall of water level about 40 feet. Fish of all species in the river are here. Mahseer up to 20 lbs. and more, large perrun and many murrel muggger. Live bait, and natural bait and spoon spinning, all successful, spoon least so, Plug not tried would probably do well. No accommodation on the South bank, a village on North bank (Dhar State) from which supplies and men can be had. Approach from Bir railway Station on G. I. P. Ry. *via* Punasa (F.R.H.) which is 6 miles from the Falls and 18 miles from Bir. Better to take men and supplies from Punasa with kind assistance of Forest Ranger. Boat necessary for access to further bank, and also to rocks in river. The South side of River is all Reserved Forest. 25 miles below is Mandhata where a number of boats. Many mahseer opposite the Temples on either bank. 7 miles below Mandhata is Road & Rail bridge over the river. Station Mortakka. Good water below the bridge. Excellent runs for gram fishing. From Mortakka to Kalghat (by water) 40 miles; and from Kalghat to next place where motorable road touches the river 40 miles (by water): all this portion of the river should be good, but probably never fished by any angler. So also the next 90 miles all of which runs through hilly country. Must be any amount of good water and probably many rapids. Only way to fish the river from Mortakka to the furthest point would be by boat, and take some considerable 'bundobast', but worth it! Certainly never been fished by anyone.
Saugor.	Betwa R.	Almost the best river in the province as fish will take a spoon and run to a decent size, for further notes on this river see under Jhansi in U. P. section. Bina, there is some very good water near here, and fish run large. Kanjia, 15 miles from Bina. Approach *via* Mamboali on Bina-Goona line. Make for Kanjia about 5

Districts.	Rivers & Tanks.	Remarks.
Saugor—(*contd.*)	Betwa R.—(*contd.*)	miles away. 1 mile below is a good run but it must be fished early, Oct. or the river shrinks and has not enough water in the hot months. Try spoon, atta and gram.
	Bewas R.	*Bewas R.* crossed at the 12th mile on the Damoh Road, and at the 9th mile by the Narsingpur Road. There is good water at both places. Best in Oct. or in a break in the rains, when one may get into a good Silund.
	Dhasan R.	*Dhasan R.* the river is crossed 10 miles from Saugor on the Jahnsi Road. It fishes well after the rains and good fish have been taken 15 lbs. and over.
Seoni.	Goorda R.	See note under Jubbulpore.
	Pench R.	See under Chhindwara.
	Wainganga R.	Chhapara, 20 miles down the Jubbulpore Road there is a R. H. near the bridge. A good pool a mile down-stream with fish of 6 lbs.

There was an Angling Association formed for the C. P. with its H. Q. at Jubbulpore, they published a Journal with a lot of useful information for the Resident or visiting Angler, but I cannot say if this is still functioning, I am talking of 1930-31.

Any one interested should try and obtain a copy of the Journal sold, I think for Rs. 2-8.

(Including Hyderabad State, Mysore State, Eastern and Western Ghats.)

8. MADRAS FISHING LOCALITIES ARRANGED BY PROVINCES.

Hyderabad State.

Within this area, or forming part of its boundaries, are the *Godavary,* with its tributaries *Pranhita, Penganga,* and *Manjra;* and the *Kistna* with its tributaries *Bhima* and *Tungabhadra.*

All these great rivers hold Mahseer and sport is to be had with them wherever there are rocks and rapids by spinning, and in deep, still pools by bottom fishing: so also with other large carp and sporting fish of several species.

For very many miles on end portions of these rivers, such as the Godavari between Nander and Sironcha and from thence down to Rajahmundry; and the Kistna from a few miles below the G.I.P. Railway Bridge north of Raichur nearly all the way to Bezwada are almost unknown to the Angler. There are also long reaches unattractive to the angler because of alluvial soil and sluggish currents. This applies to almost all of the Manjra River. Where the Renganga and Godawari run through the northern jungles of Adilabad and Nirmul those rivers offered good sport in many places.

Generally speaking the Kistna and its tributaries offered the best sport from early November when the waters begin to clear after the S. W. Monsoon, up to March or April. The Godavari and its tributaries do not fish well until somewhat later on account of the colder climate up to middle or end of January.

DISTRICT.	RIVERS, TANKS & LAKES.	REMARKS.
Hyderabad State.	Hussain Sagar & Mir Alam Lakes.	These large Lakes are stocked with all the usual species of Tank fish, and good sport can be had from the embankments. Information could be had as to baits and methods from a number of local Anglers, mostly Muhammadans. Besides these two lakes there are many large artificial Lakes and Tanks throughout the State in all of which sport could be had.
	Kistna R.	*Kistna R.* good water above the bridge for 3 miles and down-stream for a number of miles. There used to be a Bungalow, more or less unfurnished, at Devursugur 3 miles below the bridge on the right bank. Permission from the Tahsildar, Raichur. Officers of the Hyderabad Contingent had great sport in this part of the Kistna also in the Bhima (from Yadgiri) about fifty years ago. The fishing may still be good. 16 ft. fly rods and fly spoon were used, killing mahseer up to 40 lbs. and over. A portable collapsible boat is necessary. The 7 ft. Berthen was found excellent. Suitable boats not locally available.
Yadgiri Stn.	Bhima R.	Half a mile from Railway Stn. good pool and runs. Mahseer up to 40 lbs. Portable boat essential for real success. No boats available locally. Accommodation in Station waiting room. The junction of the Bhima with Kistna is about four miles above the Ry. bridge, but is not attractive for fishing.

Except as above there are no detailed note available for the Rivers and Lakes of the Hyderabad State.

Murrel: Large fish of this species are to be found in a number of the deep, spacious, masonry wells in various parts of the country. They run to 10 lbs. in weight and it is surprising that more attention to the cultivation of this excellent table fish in this manner has not had more attention in many parts of India.

Eastern Ghats.

The *Sabari* and *Sileru* rivers, in the portions of them flowing within, or on the borders of the Jeypur state afford good mahseer fishing from early February on to end of May. The latter is the larger and better river with fish up to 30 lbs. These rivers are only accessible to the turing official or the sportsman on a shooting expedition. The mahseer take spoon.

The two rivers meet at the S. E. corner of the Bastar State and the combined river joins the Godavery 20 miles south, below Bhadrachallum.

DISTRICTS.	RIVERS, TANKS & LAKES.	REMARKS.
Jeypur State.	Sileru R.	*Sileru R.* the river has that name from the junction of the Machkund R. (always muddy) with the Gurepreo, R. (always clear.). Eight miles up the latter on the left bank is a Bungalow, Janwai. The junction is at Kondakambru where is also a Bungalow. There is a fine pool at the junction. From here to Konta where the river joins the Sabari is approximately 60 miles. First 45 miles through a valley with hills on either side and forest all the way. All the Game animals and birds. Many muggers. A few riparian hamlets. Malaria prevalent. No supplies. Trip can be done by means of dugout canoes which are available from Kondakambru. Allow ten to fifteen days.
Malabar.	A number of streams; also Beypur. R. Palanted. R. and Head waters of Kabbani. R. flowing east.	Remarks as for S. Kanara.
Travancore State.		High Range. In this area are many Tea Estates. Some of the streams have been stocked with Rainbow Trout by the Planters Fishing Association which controls the fishing. Tributaries of the Periyar R., and of the Chalakudi. R. (Cochin State) hold mahseer.
,,	Periyar Lake.	Holds big mahseer which are seldom caught. Sizable fish can be got from the Dam with plug bait. Area of Lake is 14 square miles, much of it studded with dead tree trunks. Very little water escapes below the Dam. There is a mile long tunnel taking water into the plains of Madura to east of the high hills in which the lake is situated. The Periyar river enters the lake in its eastern corner. Mahseer run up the river at time of the monsoons. When the river clears spoon fishing can be good. No access to the river except by boat and nothing can be done in the lake without a boat. The fishing in the Periyar area is controlled by the Vandiperiyar Planters Fishing Association.

Madras.

The fishable (hilly) portions of the Travancore and Cochin States rivers are less accessible than those of Malabar and South Kanara.

Most of the Travancore streams, even in their remotest parts, have been practically denuded of fish by gangs of poachers; this

may also be the case with some of those further north in S. Kanara and Malabar.

The main mahseer rivers are the Godavery, Kistna, Tungabhadra, Cauvery, and Bhavani. Except as to the Bhavani no detailed notes are available.

Districts.	Rivers & Tanks.	Remarks.
Coimbatore.	Bhavani R.	*Bhavani R.* for full information see article by Lt.-Col. R. W. Burton in the *Journal of the Bombay Natural History Society,* vol. xli, 828. Season July and August and September and January February.
Salem.	Cauvery R.	*Cauvery R.* from the Sivasamudram Falls until it reaches the north corner of the Mettur Lake at the Hogenakal Falls, a distance of some 90 miles approached nowhere by motorable roads or even cart tracks, this portion of the river should afford fine sport and can have been seldom, if ever, fished by an angler for mahseer. The trip could be done with 2 coracles one for fishing, one for followers and supplies. All supplies would have to be taken, nothing available. Season from mid January to March. A good and adventurous trip well worth undertaking. Malarial precautions necessary. The mahseer would run large.
Godavari.	Godavari R.	*Godavari R.* this river is within the Madras Presidency or on its border from 30 miles below Sironcha until it flows into the Bay of Bengal near Coconada. There is good water where the river narrows below Bhadrachalam, and at a number of places where the river winds its way through the hills south of latitude 17.30 and 40 miles north of Rajahmundry. All this part of the river is known to only a few anglers who may have been serving in that part of the Presidency. No notes are available.
Kistna.	Kistna R.	*Kistna R.* from Kurnool to Bezwada the river is the Southern boundary of the Hyderabad State and Northern boundary of Madras Presidency for 150 miles below Kurnool the river flows through a deep, jungle-clad gorge which has probably never been fished by an angler for mahseer. There are no roads or cart tracks. Many muggers. The trip could only be done by basket boat as for the Cauvery. Supplies would have to be taken. The heat would be great and the sport perhaps, phenomenal! Season early November to March.

Districts.	Rivers & Tanks.	Remarks.
Kistna—(*contd.*)	Mettur Lake.	*Mettur L.* formed in recent years by Hydro Electric Dam at Mettur. Lake 30 miles long varying in width from 5 miles at widest part Depth at the Dam and about 30/40 ft. at north corner where the Hogenakal Falls former 70 ft. high. Many large fish collect at this place. Half way up the lake the Palar R. comes in from the west.
		Here follow notes from Mr. Madhavan Nilgiris.
Nilgiris.		In this area are many streams, and a few artificial lakes, which have been stocked by the Nilgiri Game Association with Rainbow Trout. These streams are the head waters of the Bhavani and Moyar rivers. Some of the lower portions are open to coarse fishing but almost all is for fly fishing only.
		All information from the Secretary of the Association at Ootacamund.
	Neyar R.	*Neyar R.* forms boundary between Nilgiris and the Mysore State and runs in a thousand foot deep gorge known as the Mysore Ditch.
		Holds large mahseer and other carp but is seldom fished on account of malarial fever of a bad type and difficulty of access.
	Tungabhadra R.	*Tungabhadra R.* borders the Madras Presidency from Harihar to Kurnool where it joins the Kistna R. Impending irrigation projects may affect the river. It is to be hoped that suitable fish ladders will be provided.
		The river holds large mahseer and has runs and rapids where sport should be good November to March.
		Distance from Harihar to Kurnool is about 250 miles and motorable roads give access at Hovanur, Hospet, Kampli, Siruguppa, Rampuram; but it is not known if sport available within reasonable reach of those places. There is said to be malaria at Kampli. A portable boat would be essential. Supplies would have to be taken.
		From Hospet 12 miles is Balasanski district and 2 marches below is Sovainhulli—a Ferry here.
Mysore State.		
		In the north the *Tunga* and *Bhadra* rivers rise in the Western Ghats to flow eastwards and meet near Shimoga whence they form the Tungabhadra river.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(*contd.*)	Tungabhadra R.—(*contd.*)	The Bhadra is the better fishing river and affords good sport to the Coffee Estate Planters of the area. Mahseer run to over 30 lbs. Further north is the *Sharavati* river which makes its way via the Gersoppa Falls (830 ft.) to the Arabian Sea. It holds mahseer up to at least 20 lbs. Recent Hydro-Electric works may have affected the fishing above the Falls. To the south the *Cauvery* river, its sources in the mountains of Coorg, having added to its waters many streams rising in the Western Ghats, leaves the State 30 miles below the Sivasamudram Falls. It is joined by its largest affluent, the *Kabbani* River, a few miles below Mysore City. Mahseer in the Cauvery and Kabbani run to over 100 lbs.* The record fish for India (119 lbs.) came from the Cauvery some 14 miles below Mysore City and the next largest (110 lbs.) from the Kabbani in its higher reaches. These large fish are mostly taken on balls of ragi paste. Where there are rocks and rapids fish up to 40/50 lbs. have been taken on spoon; but other large mahseer have been caught on both live and dead bait, and on spoons.
	Lakes.	The *Krishnarajasagara Lake* formed by a Dam across the Cauvery 11 miles above Seringapatam holds many monster mahseer which are very difficult to catch in such a deep and extensive sheet of water. The *Vanivilas Sagar* is another large Lake. It is west of Hiriyur and a hundred miles north west of Bangalore. There are other large Lakes and Tanks in all of which use of portable boats is essential to success. The State is well served by a number of motorable and other road giving access to the lakes and rivers of the country.

AVAILABILITY OF GAME FISHING FACILITIES IN MYSORE STATE.

(*Information supplied by the Fisheries Office, Mysore State*).

DISTRICTS.	RIVERS, LAKES, OR PLACE.	REMARKS.
Mysore State.	Cauvery R.	*Cauvery R.* Seringapatam 10 miles from Mysore and 78 miles from Bangalore reached by rail

* In May 1946 Mr. Van Ingen caught one of 120 lbs.

Districts.	Rivers & Tanks.	Remarks.
Mysore State—(*contd.*)	Cauvery R.—(*contd.*)	and motorable road. A good T. B. with servants is available. Surrounding Seringapatam are a few good pools for Mahseer and other carps. Doddinamadu on the 4th mile stone from Seringapatam on the way to Bluff. Two pools here are famous as containing record size Mahseers. Coracles are available. Bommanathittu, 5 miles from Seringapatam up-stream, on the way to Krishnarajasagar reservoir. Close by is a Bird Sanctuary and the pools within about 2 miles are good for Mahseer, Labeo, Carnatic carp and *Barbus dubius*. Usually baiting is practised in this spot. Coracle is available. Mudukthore, this place is 28 miles from Mysore on the way to Bluff or Shivasamudram. There is a small T. B. in Talkad, 2 miles below along the river course. The large pool formed above the weir offers a very good baiting for Mahseer and other carps. Area covered by the pool is more than 4 miles along the river. Boats are essential though coracles may be made available. Shivasamudram or Bluff, this is where the Cauvery leaves the Mysore plateau by means of two falls. Hydro-electric power generating station is situated close by and the place can be reached both from Bangalore and Mysore by road, or up to Maddur by rail and thence by bus. Spinning may be done in the rapids above. Pools below the falls contain good catfishes like Silundia *Mystus aor*, and Mahseers. A collapsible boat will be essential in the pools and rapids below. Mekedatu. This is perhaps the most unfrequented fishing spot comparatively unknown to the anglers. It is reached via Kankanahalli, 30 miles from Bangalore by road and another 22 miles from Kankanahalli by road. A total of 52 miles negotiable during hot months only. Otherwise the motor road from Bangalore to Channapatam on the Mysore road has to be used and the road to Satnur and Aladahalli a distance of about 62 miles has to be covered from Bangalore. There is a small T. B. and coracles are available. The rapids and the large pools contain record size Mahseers. From what has been gathered from the local fishermen, it

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(*contd.*)	Cauvery R.—(*contd.*)	is evident that the large pools and the rapids have very old and large inhabitants more particularly mahseers and catfishes. Coracle is availabe. Both spinning and baiting may be practised very successfully.
	Krishnarajasagar Lake.	Krishnarajasagar, the lake is formed by a large dam across the Cauvery. It is reached from Mysore either by train or by road, (12 miles). Good Travellers' bungalow available as well as a European Hotel run by the Government of Mysore. Angling is good only in the rapids below the dam in the waste-weir and the river course. Baiting may be done on the quieter pools along the river or in the reservoir itself. Rapids below offer good spinning. But the reservoir itself is not very good as it is too deep and game fishing is not tried successfully on it so far. Two miles below in a pool formed by another small weir across the river good angling for Mahseer as well as other carps and some catfishes like Wallago is available. The back washes of the reservoir in the river course near about Krishnarajnagar 18 miles by rail, and 22 miles by road, baiting may be practised successfully for Mahseer, Labeo, Carnatic carp etc. Boats are available and coracles may also be arranged. *Krishnarajanagar* is two miles from the angling grounds possessing a good T. B. with servants.
		Chunchankatte, 10 miles from Krishnarajnagar, this can be reached by a motorable road. A small T. B. is available. The rapids and pools below the weir are good for spinning and baiting and very good Mahseer may be had at all times. 6 miles above along the road is another place, Hansoge which is also good for angling and could be visited from Chunchankatte. 25 miles from Krishnarajnagar and about 16 miles from this place is Ramanathpur where a Temple Sanctuary is interesting as it shelters almost all the carps of the Cauvery. They are accustomed to human company and are very tame. Fishes ranging up to 80 lbs. (Mahseers) are seen in the pool. Angling of any kind is prohibited for about a mile surrounding this area. There is a good T. B. also in this place.

Districts.	Rivers & Tanks.	Remarks.
Mysore State—(*contd.*)	Kabbani R.	Kakankote. 48 miles from Mysore. Very good mahseer is available surrounding this area. The pools are 'palace game preserves'. Other pools not set apart are also good and may be tried successfully as the Kabbani teems with large mahseer. The river 12 miles below may be tried in the deeper pools near about Sargur. There is a good T. B. in Heggadadevankote, about 15 miles from Kakankote downstream. The pools from Heggadadevankote are between 6 to 8 miles and are reached by roads. Probably the good fishing season in this area is between October and December when mahseers breed in the pools of these head waters of the Kabbani.
Shimoga	Thunga and the Bhadra.	Shimoga. This town is reached by rail from Bangalore towards the northwest of the State. Also a good road from Bangalore up to Honnavar in North Canara which passes through Shimoga. Sacrebyle, 9 miles from Shimoga has good number of pools and abounds in mahseer, *Barbus neilli, Labeo fimbriatus* and several catfishes like *Mystus aor, Psendotropius, Bagarius.* A Small T. B. available at Sacrebyle (as well as a good T. B. in Shimoga itself provided with servants). Other pools along the river may be tried near about Sacrebyle and a collapsible boat may be very useful as there are no locally available coracles or boats. Occasionally an eel or two are also hauled.
	Thungabhadra R.	Honnali, 24 miles from Shimoga by road possesses a few good pools where mahseer, *B. neilli* and other carps and catfishes may be successfully angled for. There is a good T. B. here on the bank of the river.
	Sharavathi R.	North-west of Shimoga District is this drainage which is almost unknown for anglers. Mahseers, and other carps like *B. neilli* and Labeos are available. The camping facilities available are at Gersoppa or Jog Falls itself which is going to become a Hydro-electric generating station. There are good travellers' bungalows for staying and angling may be tried both above the Falls and below. A collapsible boat is very essential. Talguppa has a good T. B., 12 miles from Jog Falls and could be reached from pools of the river, 5 miles distance by good motorable road. Angling has not

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Shimoga—(*contd.*)	Sharavathi R.—(*contd.*)	been tried here properly by anyone though the local records show the occurrence of game fishes in large numbers.
	Sulekere Tank.	*Sulekere Tank.* 26 miles from Bhadravathi and 36 miles from Shimoga by road, this place has a good T. B. and angling for small carps up to 12 lbs. as well as cat-fishes up to 30 lbs. may be done profitably. There is no facility for boats or coracles nearby. Lot of butterfish (*Callichrous*) and occasional eel offer good variety.
Chitaldrug.	Vanivilas Sagar.	*Vanivilas Sagar* :—102 miles from Bangalore in Bangalore—Bellary road, turning west at Hiriyur. There is a good T. B. and an Inspection Lodge. This large lake is not very well stocked with good varieties of fish and it is not placed very conveniently for an angler. This lake is the second biggest in Mysore. There is good boating and a steam launch. Mahseers, *B. neilli* are recorded occasionally and several large catfishes and carps up to 15 lbs. are usually common. Eels are also caught now and then.
Western Ghats.		
South Kanara. (for N. Kanara see under Bombay).	Holadi R. Sitanadi R. Swarnanadi R. Gurpur R. Netravati R. Gundayahole R. Payaswani R. Valarpattanam R.	All rivers having sources in the Western Ghats and flowing westwards into the Arabian Sea hold mahseer in their hilly portions. Ordinarily size will not be above 15 lbs. Except where within reach of motorable roads the streams are not easy to get at. Apart from such notes as are available and given below, the interested angler can obtain information as to roads, accommodation, and rivers from the Road Map of India, and Survey of India Maps. 'The Rod in India' by H. S. Thomas, 2nd Edition, 1881; and 'The Mighty Mahseer' by Skene Dhu, 1906; should also be referred to. Mahseer in all these rivers take spoon bait, in some of them they will accept no other bait, and in some they will take fly. In some of the streams the less glittering spoons of frosted silver finish do better than ordinary bright spoons.
South Kanara.	**Holadi. R.**	*Holadi R.* this river may be fishable from the Hulikal-Hosangadi road which runs parallel, and a few miles from it, after it leaves the Mysore State. No information is available.
	Sitanadi R.	*Sitanadi R.* is crossed by the Agumbi Ghat road (motorable, Buses ply) between Someshwar and

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Shimoga—(*contd.*)	Sitanadi R—(*contd.*)	Hebri east and south of which is another stream.
	Swarnanadi R.	*Swarnanadi R.* crossed by the Hobri-Karkal road and in its upper reaches by minor roads at Mala and Miyar. No information is available.
	Gurpur R	*Gurpur R.* crossed in several places, Yenur, Marur and, to the north Naravi, by major and minor roads. No information is available.
	Natravati R.	*Natravati R.* enter sea at Mangalore. Has a number of large hill tributaries. A large tributary with many hill streams joins the main river at Uppinangadi. On the northern streams are Charmadi and Neriya mentioned by Thomas (the former on the Mudgiri—Mangalore Ghat road) and on the eastern stream is Shisla, accessible by cart track (3 miles) from Shiradi. The other main tributary also joins in at Uppinangadi. It is the Kamaradhari and has two branches. The Gundayable comes from near Manjarabad and has the Hassan-Sakleshpur-Mangalore Ghat road alongside it for about 20 miles, Buses run. Stay night at Manjarabad Club (road branches here for bisole on upper reaches of Kamaradhari which can also be got at from where the above mentioned ghat road joins with it 20 miles below Shoradi.) next day take bus and go stay Kumphulla, D.B. Fish accessible parts of river from there. Then go Gungaya where is old Forest Shed now used as a cow shed. Camp. Five miles further down is Shiradi, L.F.R.H. at mile 53 from Mangalore. Good spot 1 mile above bungalow also below. Four miles from bungalow cart track for Shisla turns off to the right. Nowhere to stay, river full of fish. Period for these waters middle September onwards. Malaria precautions necessary. See also Notes by Skene Dhu at pages 219 & 220 of his book.
	Payaswani R. add. A. F. R. H? at Parappa down-stream about 4 miles from Jalsur. Malaria.	Good looking water at Sulya which is 33 from Mercara and 52 from Mangalore on the Ghat road between these places. At Sulya from F.R.H. and from here towards Mercara the road runs within reach of the river for about 20 miles. No information available but fishing should be good. 5 miles up and down available at Sulya.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Malabar. (See also p. 236)	Vallarpattanam R. Beypur R. Palanted R. & Head waters of Kabani R. flowing East.	General remarks as for South Kanara. The Vallarpattanam R. becomes, higher up, the Valiyapuzha which rises in Coorg. A F.R.H. at Makut inside Coorg and a P.W.D. Bungalow at Kutupoya in Malabar. These only two miles apart. Other side of river from Kutupoya is Portland Rubber Estate. Ghat road runs for eight miles within reach of the river until Iritti where it is joined by the Aralam Puzha, a large stream with many hilly affluents. 4 miles up stream village Aralam.
	Beypur R.	*Beypur R.* Upper reaches fanning out in the valleys are accessible in some places from the Calicut-Gudalur road. Mahseer up to 15 lbs.

9. PUNJAB AND NORTH WEST FRONTIER PROVINCE AND BALUCHISTAN.

Abbotabad.	Siran R.	*Siran R.* From Harriapur Station, then 7 miles to Thapla fishing is good from the junction of the Dore with Siren down to junction with Indus. Bala is another good place.
	Kalapani R.	*Kalapani R.* Was stocked with trout (fario) years ago, but have since disappeard I understand.
	Dore R.	*Dore R.* Crossed near Sultanpore on Hassan-Abdul-Abbotabad road by a large bridge, but is a poor stream with very small fish.
Ambala.	Jumna R.	*Jumna R.* The only water is at the Head works of the Jumna Canal at Tajuwallah, and Dadupore. Served with a good motor road, or by railway to Jagadri station 12 miles away. The canal falls all hold Mahseer as far down as Karnal.
Baluchistan.	Rakni R.	*Rakni R.* Approached by Frontier road from D. G. Khan to Peshin, through Loralai. Best water between Mat and Rakni.
	Anambar R.	*Anambar R.* The best fishing is between Shadiani and Missi and Misri kach 20 miles from Loralai.
	Bolan R.	*Bolan R.* Train to Sibi or Nari bank and make for Kirthi Rest House or Wundalami R. H. an easy ride, Fish are all Mahseer under 15 lbs.
Bannu.	Kurrum R.	*Kurrum R.* Near Bannu and below the Kurrum Post small fish of 2 and 3 lbs. can be caught, but the best fishing is in the upper reaches above Thal extending up to Parchinar where fish of 5 and 6 lbs. have been caught.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bannu—(*contd.*)	Tochi R.	*Tochi R.* Good sport can be had with small Mahseer near Saidgi and Shinki, I have caught them as high as Edak but it is unfriendly country and hardly worth the risk unless under pickets.
Campbellpore	Hurroo R.	*Hurroo R.* Mahseer are to be had in some good rapids 10 miles out, but the best fishing is at the junction with the Indus.
	Kabul R.	*The Kabul R.* also join the Indus near here and is reported to hold larger fish.
Ferozepore.	Sutlej R.	*Sutlej R.* Sluices & pool below Sutlej Dam on Ferozepore-Lahore road (6 m. from Ferozepore & 44 from Lahore). *Butchwa* on fly (jungle cock & silver) or any lake size fly with silver tinsel about it, also small fly-spoon. *Mulley.* not uncommon and frequently taken. *Seetul,* large numbers are seen and some are caught when trolling big pools below the bridge dam. *Mahseer* are present. No information as to size there is an excellent fish-ladder. Plenty of rohu and other fish many turtle and a few garial. For all the fishing boat almost essential and can be readily obtained from local fishermen.
Jhelum.	Jhelum R.	See under Tangrote.
Kashmir.		Trout are to be had but the subject has been dealt with so thoroughly in books already in print that it is unnecessary to enumerate the rivers and localities here. A book on the rules with general information is published by the State and is obtainable for 8 annas. There are besides a number of agencies who make all arrangements for the new comer.
Kohat.	Toi R.	Small Mahseer may be had near Dobah and below.
Kulu.	Bias R.	To the intending visitor to Kulu no better guide than T. Tyson's book 'Fishing in Kulu' could be recommended. It is published by the Civil and Military Gazette Lahore. It has maps and all the information necessary.
Lahore.	Ravi R.	Butchwa and the commoner fishes can be had near the Bridges. For mahseer, journeys must be made to one of the many places listed.
	Tanks.	A number of tanks have been stocked with Labeo by Government for information apply to the Direc-

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Lahore—(*contd.*)		tor of Fisheries, who will give up-to-date information.
Loralai.	Rakni R.	See note under Baluchistan.
Murree.	Mahl R.	This river can be reached in two easy marches. Distance 24 miles to Dhalkot via Thanda. It joins the Jhelum at this point, much up-stream it is indifferent fishing with small fish. When the Jhelum is in flood and banks up the mouth of the Mahl, big fish are to be had by both spinning and on frog. See further notes on this river under Tangrot.
Pathankote.	Ravi R.	Madhojur 8 miles away is at the Headworks of the Lower Bari Dhob Canal off the Ravi R. best fishing is above the wier.
Peshawar.	Swat R.	28 miles from Cantonments is Fort Abazai, built on the river. Good fish are recorded from here, in the 'Anglers Hand Book' but times may have changed.
Quetta.	Bolan R.	See under Balauchistan.
Rawal-Pindi.	Sohan R. Korung & Chiblat R.	All within easy reach of Cantonments, and were once protected by a Fishing Club, local information is necessary or if the Club log book is available reference to notes therein will be of help.
Sialkote.	Chenab R.	*The Chenab* takes in two or three streams, the junctions of which are all reported to be good. Trolling in the deep pools has also met with success. The Jammu-Tewari? Bhab-Nala? and Khano Bhao Nala.
Simla Hills.	Giri R.	This river can be reached from Solan, from where it is 10 miles to the junction of Giri and Ashai stream, or from Salogra Ry. Stn. only 7 miles from the same junction. If planning a long holiday—Fish from here to the junction, with the Jumna about 50 miles of good fishing water, with innumerable tributaries joining in.
	Sutlej R.	This river runs north of Simla, and provides power and water and is an easy days march. For details of good fishing places local enquiries should be made.
	Bias R.	On the road to Kulu and in Mandi State some of the streams are stocked with trout. For details see under Kulu.
Tangrote.	Jhelum & Poonch.	This is probably the most celebrated spot for fishing in the Punjab and needs little introduction. It is reached from Dina Ry. Stn. then by road 16 miles or from Jhelum 23 miles by road or river. The Bungalow has a Visitors Fishing Book full of most interesting notes,

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Tangrote—(*contd.*)		Trips from Poonch can also be undertaken and are an interesting and popular approach.

This concludes these brief notes on fishing in the Punjab, there are of course scores of other places about which little is written or known, except to a select few who guard them as secret.

10. UNITED PROVINCES AND DELHI.

Allahabad.	Jumna & Ganges.	All the commoner fish are to be taken, Butchwa, Silund, and W. Attu, etc. The Jumna has much the best water of these two sacred rivers at this revered junction. It carries the greater volume of water being fed by the Central Indian Rivers. The best places to fish for Butchwa are undoubtedly around the piers of the Railway Bridge in the broken water, and in the swirls near the banks from the water works down to the Junction. The best time is from 10 a.m. to 4 p.m. when the water is clear, and at the changing of the seasons, and hot weather. *Bait.* Fly-spoon, Fly, Mole cricket or small fish will all take Butchwa, but for Silund a slowly spun bait 4 to 6 inches long is the best, or a 'Plug' may be successful. The Ganges is indifferent, though fish are visible near the Railway Bridge. It has very little water in the best Season, being drained for irrigation by Canals.
	Tons.	Small Mahseer are taken on Fly-spoon both below and above the bridge on the Rewa Road from two to four miles. Best season is after the Rains when the river clears, fish up to 10 lbs. have been caught. Fishing is good from Lohaa to Korhar about 16 miles of water.
	MacPherson Lakes.	These lakes are in the Cantonments and are well stocked with Labeo, Catla, and Mirgil. Evidence of their popularity is seen by the number of Machans erected. Fishing permits are issued by the E.O. and the Chowkidar will erect a Machan for Rs. 10/-. A Book of catches is kept by the Chowkidar and makes interesting reading. Fish are caught all the year round, the best bags are registered in September and October and part of November: Catla of 60 lbs. have been taken and Rohu of over 30 lbs. There are also tanks within a radius of 20 miles of the town, that fish well.

Districts.	Rivers & Tanks.	Remarks.
Allahabad—(*contd.*)	Balan R.	A small river in the South of the District holds small Mahseer and B. Bola. Take road to Kuraon then follow the Mirzapur road to where it crosses. Good water to Mando village down stream. This is from a friend. The Balan also fishes well in the Mirzapur district. Places mentioned in the Anglers Handbook are Buroundeth 25 miles down the Rewa Road a P.W.D. Bungalow, also a bridge. The River is 300 yards away, and fishing is good to Koolsara.
Almora.	Kosi R.	The Kosi is crossed on the way from Ranikhet, but it is a small stream here and the best fishing is lower down and above Kairhna, though it is not really good until it enters Reserve Forest one march below Kairhna, from here down to where it comes out of the hills is all good. Further west is the W. Ramgunga an excellent river and easily approached from Ranikhet, or from Ramnagar on the O & T. Railway. But for the best fishing in this District we must look East to the Surju and East Ramgunga.
	Surju R.	The water from Kapkot (D. B. Bungalow) 14 miles above Bagashwar on the Pindari Glacier road to two marches from Almora down to Rameshwar where it joins the Ramganga is all good water and fairly well provided with Rest Houses. There are some imposing Gorges along this stretch of river, and fishing is somewhat restricted, though they are worth any amount of trouble as they hold huge fish of 50 and 60 lbs. Kit must be carried by coolie, as the pony track leaves the river in places, and good water is missed out. Bait. This is a chilwa or dead bait river, and gives far better results than spoon, except for the light work with Fly-spoon. The best water is lower down and I would recommend making for Upper Shera Ghat 29 miles from Almora. From here down to Rameshwar is all good water taking in the R. Ramganga here it flows on for another 6 miles to join the Kali at Pachashwar, making a wonderful junction and which I think is the best water in Kumaon. There are monster fish here and it

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Allahabad—(*contd.*)	Surju R.—(*contd.*)	is not unusual to be running fish all day. The best time is March and April, May is a bit late, besides it gets oppressively hot.
	East Ramgunga.	This river is still further East and runs on a parallel course, more or less from Tajam to Rameshwar with the Surju. It is a river of deep un-approachable gorges, which has to be approached in certain portions and only after long marches and much climbing. It can be approached (1) by crossing the Samapass above Kapkot, and working down the river to Rameshwar to the Junction with the Surju. I have done it once, but it proved more an adventure than successful fishing. A boat to work down through these gorges would be an experience well worth trying, there is certainly no other way of doing it. It holds enormous fish, (I have a belly scale of a fish I foul-hooked in this river that is the size of the palm of the hand). It is a much faster and larger river than the Surju.
	Gori R.	Still further East is the Gori a raging torrent almost all the way down to its junction with the Kali. It offers wild scenery and good shooting, but has proved a disappointing river to fish for mahseer. I feel sure it would, with its many feeders, make an excellent Trout river.
	Gonah Lake.	Is not in the Almora District but in Tehri Garhwal. One of the easiest ways to it is from Almora so I have included it here. It has an abundance of trout, and the angler is amply repaid for the long and arduous 'trek' of getting there in 7 or 8 marches.
Baraich.	Sarda R.	Katernian Ghat on O & T. Railway is on the bank of the River fish have been taken both above to the Nepal frontier and also a few miles down, small Mahseer and B. Bola. The best fishing is to be had in Nepal to a place called Chisapani 32 miles inside. But for this, special permission must first be obtained and this is not easy. The arrangements for getting supplies and transport are a further difficulty, as it is wild country with very poor roads.
	Surju & Rapti.	These two rivers in the North East of the District should be good but the best water is in Nepal.

Districts.	Rivers & Tanks.	Remarks.
Benares.	Ganges R.	Butchwa and other predacious fish can sometimes be caught by the keen angler near the Pontoon and Railway Bridge, or if one wishes to catch the foul feeders, the outlet of the sewage drain below the Railway Bridge worm will provide '*sport*'.
	Tanks.	The Benares State have some nice tanks well stocked with Rohu, but permission must be obtained. There is also a very pretty Bungalow at the Reservoir at Naini 20 miles out, below the dam is a pool full of elusive fish which is protected by the State. It would be well worth a visit in October after the water had cleared or after baiting with gram.
Dehra Dun.	Ganges. Song & Suswa & Asan Rivers.	All but the first named are protected for part of their length by the D.D. Fishing Association from whose books full details can be obtained. The Ganges is best at Lachmanjhoola, Rikkikesh, Tajuwallah? and at Hardwar, but care must be taken to avoid Temples and Sacred ghats etc. in order to avoid any chance of unpleasantness.
	Ganges Canal.	This information could be obtained from the Collector of Dehra Dun or the local Canal Authorities. The falls below Hardwar are at approximately 3-mile intervals, and fish well at times, I have had excellent sport at Patri Falls. A key for the road gates must be obtained from the R.E. in charge, who is as often as not himself a fisherman and would be helpful if called upon. The falls used to fish well as far as Delhi but the Hydro Electric grids have spoilt falls from an Anglers point of view.
	Jumna R.	*Jumna R.* In the west of the Doon is the Jumna, and with the Asun affords good fishing. Full details are obtainable locally and through the Association.
Delhi.	Jumna R.	*Jumna R.* At Okhla-14 miles excellent fishing can be had with Mahseer and the predacious fish, when a fish run is on and the small fish have collected. Silund if on the feed will give grand sport. Some good sport has been had at the overflow. It is necessary to have someone on the spot to send information of the fish running, generally just before and after the Monsoon.
	Ganges Canal.	*Ganges Canal.* The falls at Dashna were good but are probably spoilt, with those in the Meerut District, by the many grids erected.

Districts.	Rivers & Tanks.	Remarks.
Benares—(*contd.*)	Roshnara Tank.	*Roshnara Tank* is well stocked with Rohu and is well known. There are besides a number of old tanks in and around the old City.
Gorakhpore.	Gandak R.	This river borders on the East of the District and although the Malars at Tirbhani catch fish of 20 lbs. and over, I have only heard of small Mahseer being taken on spinning bait. There are few rapids and it has been little tried.
	Tanks.	A poor station from the Anglers' point of view, though there are a few tanks which hold *Labeo*. Butchwa can be had in the small streams draining the District at pontoon bridges, junctions, etc. while the large lakes hold Murrel in large quantities.
Hardwar.	Ganges	See under Dehra Dun.
Jhansi.	Betwa R.	*Betwa R.* Mahseer and trout (B. Bola) can be had down the Nowgong Road. $7\frac{1}{2}$ miles from Jhansi. Paricha 15 miles down the Cawnpore road is probably the best water near at hand. There are other places but off the beaten track and at greater distances. Other small streams worth a trial with light tackle during or just after the Monsoon are the Barbari, Pahuj, and Dhurari Nallahas, all within easy reach of the town and served by good roads.
	Burwa Sagar Tank.	*Burwa Sagar Tank* 13 miles out affords the tank angler with all he desires.
Landsdowne.	Nayar R.	*Nayar R.* A tributary of the Ganges. Rail to Kotdwara and make for Bang-Ghat 29 miles where there is good water all the way down to the junction, fish of 30 lbs. have been taken.
Lucknow.	Gomti R.	*Gomti R.* Lucknow has no fishing to write about except perhaps a few butchwa in the Gomti and Rohu in tanks dotted about, but it is well situated, and one can get to good water in a nights journey.—The Sarda at Tanakhpore, the Girwa at Kauriala on O & T. Railway, Betwa at Jhansi.
Meerut.	Ganges Canal.	The canal has a number of falls at easy distance from Cannt, (see remarks under Delhi) Fishing with atta paste at the cattle crossings and drinking places sometimes provides good sport.
	Hinden R.	Hinden River is very popular with Indian Anglers who get good fish of the pariah types, but details are lacking.
	Tanks.	The only tank I know of is $7\frac{1}{2}$ miles out on the Hapur Road, it holds *Labeo*.

Districts.	Rivers & Tanks.	Remarks.
Naini Tal.	Gola, & Kosi. R.	The *Gola* at Ranibagh, and *Kosi* at Kairhna and below both give sport if hit off at the right time.
	Nandhaur R.	*Nandhaur R.* Runs through Reserved Forest it is situated 12 miles East of Haldwani on O & T. Ry. It is connected by motor road, and has F. R. Houses. The best fishing is above, where fish of 10 pounds or more can be had on fly-spoon. Camp at a chowki called Selakul 5 miles from Chorgalia. Best seasons are Feb./March and after the rains.
	Lakes.	The lakes at Sathtal Naukatia and Bhimtal are well known, and easy to get to from either Naini Tal or Bhowali. It is pretty fishing with fly, the fish seldom run above two lbs. and are poor fighters. Kurpa Tal on the Kaladungi Road is also worth a trial, but Nainital is disappointing, and the fish are dying off yearly.
Philibhit.	Sarda R.	*Sarda R.* Tanakhpore is within easy reach, and has some good water above and up to the Punigari gorge above the Boom at Barhamdio. Opposite the Forest Rest H. and down to Bombasa it fishes well in the hot months and before the snow water comes down. The canal itself should hold fish though I have no first hand information of anyone fishing it or catching anything.
Tanakhpore.	Jumna R.	*Jumna R.* There is good fishing to be had in the North of the District, in the many streams that flow into the Jumna, or Ganges. Notes and Names of places are not available to include here.
Saharanpore.	Ladhya R.	*Ladhya R.* Though in the Almora District, it is best approached from Tanakpore, 7 miles up the Loharghat Road, the Ladhya is crossed at Chalti. From here to its junction with the Sarda at Chuka—a distance of 14 miles—is all excellent water for B. Bola and Mahseer up to 15 pounds. Best season is Oct./Nov. or just after the monsoon.

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